ELECTRICAL REVIEW

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ELECTRICAL REVIEW

13 February 1959 Vol. 164 No. 7 Established 1872

Prices and Competition

THE declaration by the Restrictive Practices Court that the minimum price agreement of the Yarn Spinners' Association is contrary to the public interest is of great importance to industry generally. It is the first clear indication of the effectiveness of the Restrictive Trade Practices Act and one result will probably be to increase the rate at which agreements now on the register are abandoned before they reach the Court.

The Act contains a strong presumption in favour of open competition, and the present case has emphasised that the " gates " through which an agreement must pass if it is to be deemed in the national interest are extremely narrow. The Court also explained that it reached its verdict on a strictly legal interpretation of the Act and that it has no power to modify the consequences of its findings. The fact that the Court was not deterred by the inevitable rise in local unemployment is of special significance.

There is, however, no reason to presume from this that all agreements on prices will suffer a similar fate. The judgment delivered by Mr. Justice Devlin contained several indications as to the type of agreement and other circumstances that might have led to a more favourable verdict. There was here at least some encouragement for manufacturers of heavy electrical plant, whose price agreements are more realistic and flexible than that considered in the Yarn Spinners' case. Also the nature of their products and the special conditions and significance of the industry are vastly different. Nevertheless, electrical manufacturers must realise that their well-established practices, which they sincerely believe to operate in the national interest, may not be allowed to continue. And even if they are, this does not mean that level prices will be any more popular or the need for them better understood.

A major criticism of price agreements both in this case and throughout post-war legislation on monopolies has been that they hinder modifications in the structure of industry in line with changes in the economy of the country. Though the need for rationalisation was recognised by many in the cotton spinning industry, little was done. As a result changes must now

take place suddenly and at a time of deep recession.

British electrical manufacturers, unlike the cotton spinners, can reasonably think in terms of expansion, but the extent to which they participate in the growth in world demand for electrical goods depends on how they prepare themselves to meet it—an obvious truth, but one acted upon by few companies. There is definite scope for a greater degree of real co-operation in tackling the problems involved in increasing exports. At home economic pressures and technical advances in the electrical industry are causing many changes that would be more smoothly and rapidly achieved if within the accepted competitive framework there was more discussion between manufacturers of general commercial matters. The industry should know, and make known, its own mind on such questions as its future course of development and be able to propose solutions before they are forced on it. An ability to look at themselves more objectively might help manufacturers when they come to present their case for level prices to the Restrictive Practices Court. It would also be an insurance should this case fail.

ALTERNATOR REGULATION

Of the many merits of the recently developed continuously acting field regulator for alternators as shown in the tests described by Messrs. Mason, Aylett and Birch in their I.E.E. paper, reported in this issue, the one of most immediate moment appears to be the reduction in short-circuit ratio thus made feasible. The consequently lower weight and bulk, in addition to that brought about through overall hydrogen cooling and direct conductor cooling, considerably facilitates transport from the manufacturers' works to the power station site.

Other advantages, such as stable operation over a wide range of power factor and the surmounting of the formidable difficulties due to loss of synchronism, apply more to exceptional conditions. So does the ability to parallel machines in emergency should synchronising equipment fail. Provided the stator end windings are found to stand up to repeated heating and the mechanical forces involved, self-synchronising in this way seems possible as a normal method of obtaining completely automatic control in some circumstances.

TRACING INSULATION FAULTS

It is clear from the article "Electrical Insulation Faults" by Mr. H. F. Church, which appears elsewhere in this issue, that very considerable importance is attached to the initial and superficial examination of equipment and material when seeking for faults in electrical insulation.

Such examination includes the observation of unusual appearances of the dismantled faulty portion of the equipment, be it cable, switchgear, condenser, or so on, punctures or breakdown tracks, and signs of corrosive deposits. Even examination of non-faulty regions of the insulation where partial deterioration may be detected is most important, because the evidence of the actual cause of breakdown is often entirely destroyed by the energy of dissipation in the breakdown itself. The usefulness of special and often powerful lighting (ultra-violet, for instance) in making such observations is also stressed.

The harmful effects of contamination of dielectrics by soldering fluxes are shown to be very considerable, and on the whole the article indicates the outstanding importance of the utmost cleanliness in the place of manufacture, assembly, installation and repair of the equipment, and in this connection we may mention particularly the jointing of e.h.v. cables.

FLOOR WARMING COLLABORATION

Over the past few months we have devoted much space to electric floor warming, believing that it has great possibilities both from the heating point of view and as one means of improving the electricity supply load curve. Although floor warming is at least as old as the Romans, the introduction of the electrical method has raised many problems of technique and practice.

Therefore, although we usually deprecate the proliferation of associations in the industry, we believe that there is a niche for the Electrical Floor Warming Association whose formation we record in this issue. Eight firms concerned in the business are the sponsors of the new body whose declared objects are, *inter alia*, to raise the standards of floor warming; to exchange technical information "involving broad principles"; and to represent the interests of members and users. In view of the last object it might seem that membership should be on a broader basis and perhaps that will be considered by the new Association.

NUCLEAR POWER AGREEMENT

While "official" satisfaction has been expressed at the conclusion of an agreement between the six Euratom countries and the British Government regarding the provision of nuclear power stations and fissile material, the views of firms concerned in the business are not so favourable.

It is not that there is anything objectionable in the agreement itself. The fear is that while the other countries may benefit from the exchange of information for which the agreement provides, Great Britain will derive little from it as matters are at present. It is felt that the Americans have a considerable advantage in quoting for nuclear power stations, mainly because of the offer by the United States Government of a 10-year supply of enriched fuel for American reactors on easy terms. The terms under which the Government undertakes to provide fuel for British-built, and possibly other, reactors are plainly stated to be strictly "commercial."

ELECTRIC FLOOR HEATING PRACTICE

The series of five articles on this subject, by Mr. R. D. Jackson, published in the "Electrical Review" during December and January, are now available in booklet form. Applications for copies of the booklet (7s 6d each post free) should be made to the Publisher, "Electrical Review," Dorset House, Stamford Street, London, S.E.1, as soon as possible

Electrical Insulation Faults

The assessment of the prime cause of failure or of unsatisfactory performance of materials, components or apparatus requires a wide experience in the field of fault finding and a knowledge of the various mechanisms of insulation failure

SPECIAL TEST METHODS

By H. F. CHURCH*

INSULATION failure is undoubtedly responsible for the majority of breakdowns of electrical equipment in service. Even when the apparent failure is that of a conductor such as an inductive winding or heating element, the breakdown is often initiated by corrosive or other effects for which unsatisfactory insulation is responsible. The establishment of the cause of failure is often difficult because extensive damage during the actual breakdown process destroys much of the evidence or because of the obscurity of the phenomenon leading to the initial deterioration.

The nature of dielectric breakdown has been for many years, and still is, the subject of intensive fundamental study by the Electrical Research Association and much literature illustrating the diversity of the phenomena involved is available. For general information from this source see references 1, 2 and 3.

In this article the writer describes the general procedure followed and some of the special methods which have been developed for the detection of faults leading to failure of insulation.

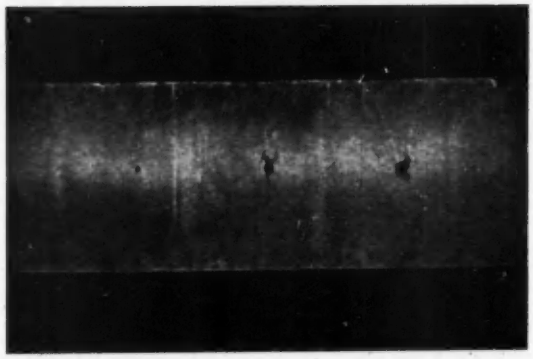
General Examination of Faulty Insulation

In the investigation of faulty or broken-down insulation the first step is to obtain all possible information as to the conditions under which the failure occurred. It is important to know (a) the magnitude of the electrical stress to which the insulation has been subjected; (b) whether the stress was a.c. or d.c., and, if d.c., the polarity; (c) whether the stress was applied continuously or only intermittently; (d) the frequency and magnitude of surges, if known; (e) the range of operating temperature; (f) the atmospheric humidity to which the insulation was exposed; and (g) any peculiarities of the operating conditions, e.g. atmospheric pollution or excessive vibration.

Such information gives a valuable lead as to the likely cause of failure. For example, if the insulation was operating under high-voltage a.c., failure from gaseous discharges or corona may be suspected. These may occur between high-voltage conductors and solid insulation if the contact between them is not intimate or at the edges of conductors where they meet a solid insulating material. Such discharges may gradually carbonise organic insulation and cause conducting channels to penetrate through considerable thicknesses. Voids within solid insulation can likewise lead to discharge breakdown. Even with inorganic materials such as porcelain, mica or glass, severe discharges can cause erosion and the propagation of breakdown channels or fissures through the material, although the life is usually much longer under such conditions than when the discharges impinge on organic insulation. If the equipment operated under low- or medium-voltage d.c., electrochemical deterioration is the probable cause of failure, especially if moisture ingress or other contamination has occurred. Failure of this type results from a gradual electrolysis of the insulation leading to corrosion or gas evolution. The phenomenon is similar to electrolysis in aqueous solution except that, since in insulation the currents are small, the effects take place at a much lower rate. If reliable information is available as to the nature or source of the insulating material, it will save the investigator the often difficult task of identification.

After noting the conditions of operation of the equipment, the investigator should undertake a general examination of the state of the insulation and associated conductors. He usually has an easier task if it is possible to examine the insulation *in situ*, or at any rate with the associated conductors still in place. If it is necessary to dismantle the faulty portion of the apparatus or equipment, this should be done carefully, noting at each stage any unusual appearance, however seemingly unimportant or unconnected with the failure. The positions of punctures or of breakdown tracks are ascertained and signs of corrosive deposits or carbonisation are noted. Although

Fig. 1.—Penetration of soldering flux into an impregnated paper dielectric; fluorescence under ultra-violet light. (Actual width of paper, one inch)



* Mr. Church is with the Electrical Research Association.

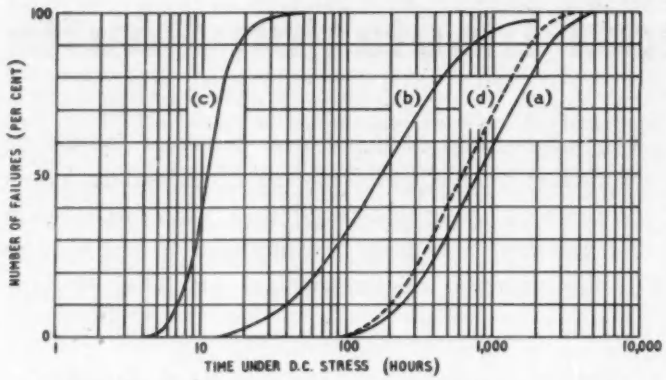


Fig. 2.—Effects of contamination by soldering flux on the life of impregnated paper capacitors at 71 deg C and 445 V/mil

(a) Connections soldered without flux. (b) Connections soldered by dipping in rosin. (c) Connections soldered using rosin-cored solder. (d) Inserted connections (no soldering)

the energy dissipated in breakdown often destroys evidence of the cause of failure, examination of other regions of the dielectric may reveal signs of partial deterioration arising from the same cause. For example, the occurrence of gaseous discharges may be revealed by bleached or carbonised areas of the dielectric, or, in oil-impregnated insulation, also by the presence of a waxy polymer of the oil (cable wax). The observation of inhomogeneities in insulation may in some cases require special lighting. For example, in an examination of faulty high-voltage glass insulators the presence within the glass of numerous air bubbles, many of them greatly elongated in the direction of the electric field, was not known until the insulators were examined in a suitably directed powerful beam of light. Corona within such small air pockets could lead to breakdown.

Fluorescence under Ultra-Violet Light

Observation of fluorescence in ultra-violet light is worth while as a routine procedure. An ordinary u.v. analytical or "black" lamp is quite suitable for the purpose. Fluorescence often shows up local changes in the dielectric which are not otherwise obvious and may reveal the presence of impurities near the breakdown site which have diffused from some other part of the system, e.g. soldering fluxes, sealing compounds. Fig. 1 shows how flux from rosin-cored solder had penetrated into a paper capacitor dielectric with chlornaphthalene impregnant and led to early breakdown. This could not have been seen under ordinary light. Life distribution curves of such capacitors contaminated with soldering flux are shown in Fig. 2. The very serious effects on life of this form of contamination can be seen, the average life being reduced nearly 100 times in bad cases. Changes which have taken place as a result of electrochemical action are often seen as an appearance of or change of fluorescence, e.g. in capacitors of the type just mentioned severe electrochemical deterioration is indicated by bright yellow fluorescence of the aluminium cathode, again suggesting some impurity. Wax formation resulting from discharges in oil-impregnated paper capacitors, which is not readily removed by organic solvents, is shown up very clearly by a blue-white fluorescence.

Microscopic Studies

The optical microscope is, of course, essential for detailed examination of faulty insulation, and for general purposes a low power stereoscopic instrument is the most useful. The use of optical filters, polarised light, microscopic stains and special immersion techniques may often help, although general rules cannot be given as to the best procedure. The treatment in particular cases depends on the nature of the material under examination and must be left to the investigator's judgment.

An example where the use of polarised light under the microscope proved to be valuable was in the examination of thin polystyrene film used as a capacitor dielectric. Faulty capacitors were found to occur as a result of the inclusion of small greasy particles (specks of dandruff from the scalp of machine operators) either during the manufacture of the plastic film or whilst winding the capacitor unit. These resulted in holes being drawn in the film during the heat treatment of the units due to local relaxation of the polystyrene. This was clearly shown in polarised light. The effect is illustrated by Fig. 3 which shows particles, resulting holes and adjacent relaxation of the plastic (light areas of diffused outline). Microscopic stains helped to reveal the nature of certain harmful impurities of botanical origin in electrical insulating paper. This particular paper was made from hemp fibres derived from the plant stem. The harmful inclusions were fragments of the epidermis of the leaf of the plant, an example of which is shown in Fig. 4. These contained injurious substances which led to rapid electrical breakdown when the paper was impregnated and operated under d.c. stress.

Conducting Inclusions in Insulation

Accidental occurrence of gross conducting or partially conducting inclusions in insulation causes local stress concentration and accelerated deterioration, but this is rare and would be obvious during a "post-mortem" examination of the equipment. Where, however, insulation is very thin, as in the case of capacitor tissue paper and plastic films, which may be of the order of 0·5 mil thick, the exclusion of very small dust particles is often most important. Conducting particles in thin films have been shown to be usually of a carbonaceous nature and are in fact coke-like particles derived from factory and domestic flues. Particles of the size observed in such films would be carried to a considerable height from a

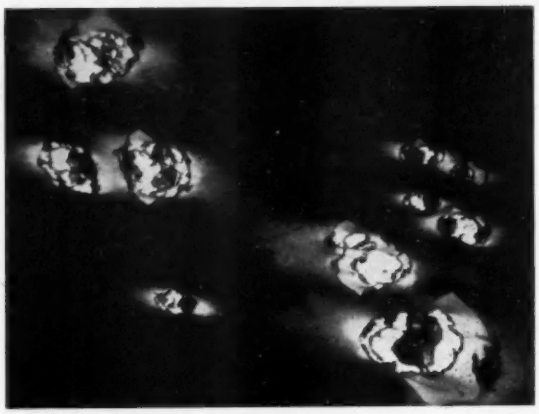


Fig. 3.—Dandruff particles in polystyrene film as seen under polarised light (magnified ten times)

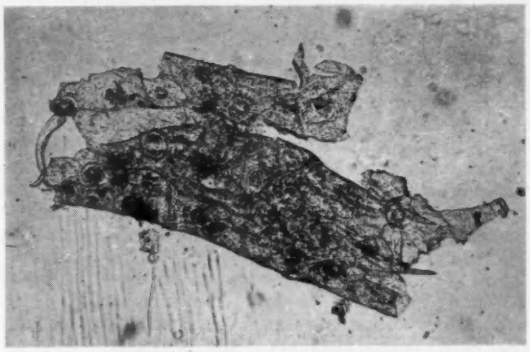


Fig. 4.—Fragment of hemp leaf in paper made from hemp fibres (magnified one hundred times)

chimney and, in a wind, conveyed to great distances before settling. Their identification required the development of a micro-electrode apparatus so that electrical tests could be applied to individual particles whilst under the microscope. Resistance-current curves for typical particles in a 0·5 mil capacitor tissue paper are shown in Fig. 5, compared with those for actual particles of finely powdered coke of the same size measured with the same apparatus. The similarity of the two sets of curves helped to establish the carbonaceous nature of the particles in the paper.

Current Distribution in Insulation

Although varnish impregnation or coating of cellulosic materials (paper, cotton yarns or fabrics) affords protection against moisture, it does not prevent indefinitely the absorption of water by such materials in damp situations. This can cause high dielectric loss leading to thermal breakdown or high leakage currents and resultant electrochemical corrosion. Even glass fibre insulation is not immune from the effects of moisture, especially where moisture and warmth are combined; such trouble is reduced if a suitable type of glass is used, i.e. the glass should be alkali free.

Sometimes high current density through insulation is very localised and it may be possible to investigate current distribution qualitatively by a special technique developed by the E.R.A. which makes use of a "printing-out" phenomenon occurring when d.c. is passed through a photographic emulsion. Where it is possible to interpose a thin gelatine emulsion in the current path, non-uniform current distribution can be demonstrated with the technique. If the current is allowed to pass through the gelatine film for a sufficient length of time a silver "image" is obtained which should be developed and fixed in the usual way. This procedure was successfully used recently in the detection of crazing in the vitreous enamel insulating covering on wire-wound resistors. Fig. 6, obtained in this way, clearly shows crazing on two different makes of resistor that was quite invisible by optical methods. This picture was obtained by wrapping around the resistor firstly a thickness of sensitive gelatine film, then a strip of thin metal foil, the two layers being firmly pressed against the surface of the resistor. On applying a d.c. voltage between the metal foil and the resistor winding in a damp atmosphere, the observed pattern was produced as a result of current passing down the moist conductive edges of the cracks. The presence of cracks was confirmed by measurement of the resistance between the winding and an outer water electrode, as in Fig. 7; when the enamel coating was cracked the resistance was less by a factor of about one million. In the examples illustrated the crazing promoted corrosion of the fine wire winding of the resistor under humid conditions. The same technique, using photographically sensitive gelatine, showed that contact with a semi-conducting glaze on a porcelain insulator was not uniform but at isolated points on the surface. Similarly, it was shown that current flows through the oxide film dielectric of an electrolytic capacitor mainly at local faults.

A modification of the technique was developed to reveal invisible cracks in semi-conducting glaze on high-voltage insulators. Direct current is passed along the glaze whilst photographic gelatine film is pressed firmly on to it by means of a rubber pad. Where cracks are present across the current path silver "trees" in the emulsion are observed to grow towards the anode, even when the cracks are too fine to be seen under the microscope or to be revealed by other methods of crack detection. In Fig. 8 are shown the effects of successive thermal shock treatments on an area of semi-conducting glaze. In ordinary operation of an insulator glazed in this way minute corona discharges across such cracks eventually spread and destroy the semi-conducting property of the glaze. This is a destructive effect

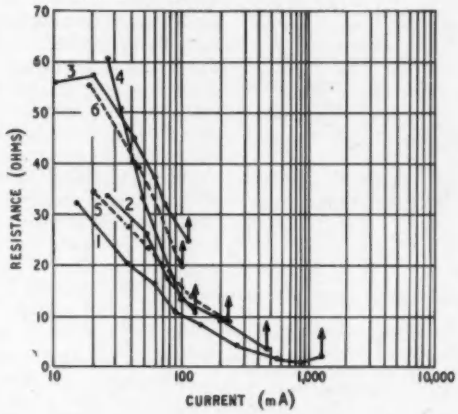


Fig. 5.—Resistance-current curves for conducting inclusions in insulating paper (1 to 4), compared with similar curves for powdered coke particles of the same size (5 and 6); arrows indicate sudden and high resistance rise. (All particles two to four mils in diameter)

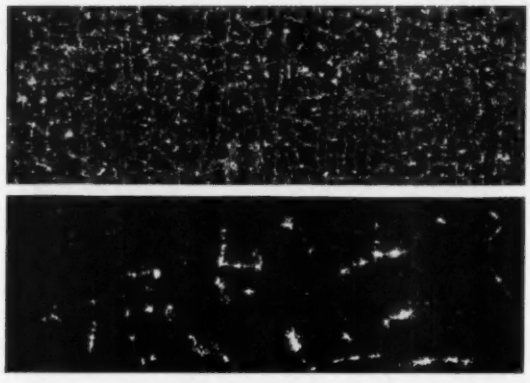


Fig. 6. — Crazing of the enamel on vitreous enamelled wire wound resistors. (Magnified three times)

additional to the electrochemical corrosion shown by the C.E.A. Research Laboratories to occur in damp situations (Ref. 4).

Chemical Tests

Where the presence of chemical impurities is suspected this can be checked by means of standard spot tests or by chemical or micro-chemical tests on extracts from the insulation. Recommended methods for estimating deleterious substances in fibrous electrical insulating materials are described in B.S. 2689 : 1956. These include methods for testing chloride content, sulphate content and acidity or alkalinity. In the case of synthetic resins, excessive acidity or alkalinity may show that an unsuitable type of material is being used. Simple tests are also available for revealing under-cure which may cause unsatisfactory performance and which can be applied to insulation which has failed, e.g. blistering at temperatures below the normal blistering temperature for the type of material. In some amino mouldings boiling in dye solution reveals under-cure.

Although direct chemical attack by impurities in the absence of applied electric stress may cause corrosion of conductor windings especially of fine wires, it does not often cause failure of insulation directly. What is much more serious is the fact that impurities which dissociate in the insulation cause increased leakage current under stress, and this may lead to gradual and progressive electrochemical failure. This type of failure is so serious, in solid as well as in liquid insulation, that special methods of test for ionic impurities have been evolved. Electrolysis in insulation can cause corrosion of electrodes and deterioration of the dielectric, the severity of which depends upon the nature of the impurities and the type of insulation. It can be important at power frequencies as well as under d.c. stress.

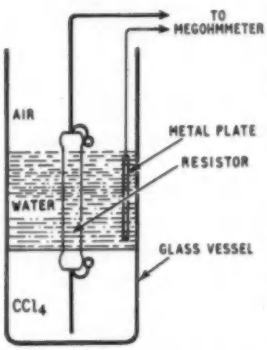


Fig. 7.—Water electrode floating on carbon tetrachloride, used in testing vitreous coatings on wire wound resistors

In the case of impregnated paper capacitors the avoidance of impurities is especially important when chlorinated hydrocarbon impregnants such as chlordiphenyl or chlorinated naphthalene are used because of the electrolytic formation of hydrochloric acid at the cathode. This acid rapidly corrodes the metal foil electrodes and attacks the paper, resulting in short life under stress, especially when working at elevated temperatures. This electrochemical reaction can be delayed by the addition of a small proportion of a hydrogen-accepting stabiliser such as anthraquinone or azobenzene.

Electrochemical Impurities

(i) Where moisture has ready access to insulation, hygroscopic impurities can have serious effects since they cause high leakage currents. If the impurities are chemically active they can lead to metal salts being formed at the electrodes which gradually permeate the insulation and result in breakdown. The well-known "greening" of cotton-covered conductors is an example of this, where the impurities may be a lubricant or size used in the spinning of the cotton or a constituent of a varnish used to impregnate the wire covering. Such impurities may be investigated by examination of an aqueous extract of the insulation. The electrical conductivity of an extract prepared by a standard procedure gives an indication of the concentration of impurities in the insulation, but not of their chemical activity. Chemical activity is best checked by specific tests on the extract, e.g. for the presence of acidity or of chlorides. Corrosion liability can also be checked by artificial tests simulating electrochemical effects. One such test in course of development measures the corrosion of copper in contact with the insulation in a damp atmosphere with d.c. applied. A test of this type can be applied to sheet insulation such as insulating tapes or to insulating sleeving.

With soft rubber insulation, especially latex rubber, natural hygroscopic substances may be present which are not readily extractable from the vulcanised product. Their presence may be revealed by electrical tests on the rubber itself after prolonged exposure of the material to moist atmosphere. With poor rubber, electrical conductivity increases considerably during exposure. This was found to be a cause of abnormal failure of electricians' rubber gloves at test voltage after storage.

(ii) In relatively dry insulation, and even in vacuum dried and impregnated dielectrics, impurities may dissociate in the dielectric itself and cause increased leakage current. For example, traces of soluble organic or mineral acids may be present in the dielectric as manufactured, may diffuse into the dielectric from its surroundings or may be produced by chemical changes in the dielectric under working conditions. The increased current can result in harmful electrolytic effects, depending on the nature of the ions in relation to the dielectric and electrodes.

Many examples of premature failure in service of paper capacitors impregnated with chlordiphenyl or chlornaphthalene have been investigated by the writer, and in nearly all cases failure has been shown to be due to this cause. Especially interesting examples concerned chlordiphenyl impregnated units which were initially free from impurities but gave trouble because of the inclusion in the capacitor container of miscellaneous materials containing harmful impurities. In one type of capacitor the impurity was initially present in a pressboard case lining and in another type in a piece of pasteboard included in the unit. Impurities have also been found to be present in gummed paper labels used to prevent units unravelling after winding, and in fibre terminal washers.

The presence of impurities can be checked by extracting the suspected material for a long time with the hot clean impregnant and measuring the increase in conductivity of the impregnant. A much quicker and more sensitive test is to make the extraction with pure trichlorethylene. Extraction of one gram in ten millilitres of solvent caused an increase in conductivity with the materials mentioned above of fifty times in the case of the pressboard and of several thousand times with the pasteboard. Substitution of a material which was satisfactory in this test brought about an immediate improvement in the life of the capacitors. Tests of this type should be applied as a routine measure to all materials used in capacitor construction.

(iii) In inorganic dielectrics, e.g. ceramics and glass, ions may be present which migrate in d.c. fields, especially at elevated temperatures, and lead to failure. These are not extractable by ordinary solvents, but may cause a change in appearance of the material and result in high conductivity after long continued application of d.c. stress; or, with some kinds of impurities, they may cause corrosion of terminals or windings.

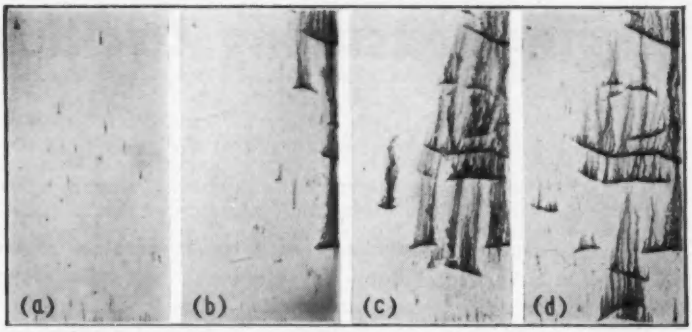


Fig. 8.—Effects of thermal shock treatments on semi-conducting glaze : (a) unshocked, and (b), (c) and (d) after one, two and three shock treatments, respectively (actual size)

(iv) Signs of migration of metals into glass and other inorganic or organic insulation under d.c. stress in moist situations may be observed. This is especially serious where silver electrodes are used. Under these conditions conductive tree-like deposits of metallic silver grow from the cathode and may eventually form conductive tracks across the insulation.

Chromatographic Analysis

Impurities in insulation which are soluble in organic solvents can often be separated by chromatography, e.g. on filter paper or on an alumina column, using a standard technique such as in solution in petroleum ether followed by development with ethyl alcohol. The technique may be applied to transformer or cable oils, liquid or solid impregnants and other insulants. The separated components may be tested for ionic activity or by chemical analysis.

The foregoing are procedures which are regularly employed in the study of the failure of insulation in equipment or components. Sometimes methods of test are specially developed in unusual cases. Mention may be made of the construction of a micro-spectrographic apparatus for investigating glow at the edge of deposited metal electrodes on high-permittivity ceramics under high-frequency stress, which was responsible for edge breakdown. This apparatus helped to show that the edges of the electrodes were glowing hot as a result of power losses in the ceramic. Again, in the study of surface contamination on aluminium foil used in capacitors, a special procedure was used for examining surface tension effects in contact with oil. In an attempt to identify faults in anodised aluminium oxide films, irradiation of the foil in an atomic pile was employed, followed by tests of local radioactivity.

This account illustrates the very wide range of experience and the variety of physical and chemical testing techniques which may be required in tracing the causes of failure of insulation which has broken down in operation. Satisfactory performance of electrical apparatus and equipment can sometimes be checked before failure occurs and in this connection the E.R.A. discharge detector and dispersion meter have useful application (Ref. 5) and are coming into increased use in industry. Very localised deterioration is not, however, always detectable in its early stages by electrical measurement, and experience in examining faulty insulation emphasises the importance of a constant check by manufacturers on the quality of all materials used in the construction of electrical equipment.

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EUROPEAN POWER STATION PLANT

THE eleventh "Survey of Electric Power Equipment" compiled by the O.E.E.C. (106 pages including numerous tables and graphs; obtainable from H.M. Stationery Office, 10s) contains two sections. In the first is presented data concerning technical developments and capital equipment of generating and high-voltage transmission systems of each of the 15 member countries. In the second part particulars are given of orders in hand and deliveries with an estimate of manufacturing capacities.

The situation at 1st January, 1958, is compared with that in 1956 onward with an indication of trends up to 1961 (inclusive) in which year new plant installed is expected to aggregate 11,412 MW compared with 9,963 MW as planned for last year. The difference will be mainly composed of thermal plant, the annual additions to the capacity of hydro-electric plant remaining fairly constant at about 3,500 MW owing to increasing difficulty in obtaining economically exploitable sites. An increase of individual ratings up to and over 200 MW is notable, while the proportion of sets of less than 10 MW will probably continue to fall from the 5 per cent of 1956 to 1·5 per cent by 1961; such small units will be mostly diesels or gas turbines in industrial works.

In transmission the trend towards higher voltages proceeds. The length of lines brought into service or planned for 380 kV in 1961 is expected to amount to 543 km, compared with 977 km in 1958.

Deliveries of equipment by members of the O.E.E.C. to other countries have varied greatly from year to year with an annual average over the past ten years of one-sixth of the total output. At 1st January, 1958, orders for delivery within the next four years to non-member countries of the O.E.E.C. accounted for one-quarter of the total manufactured output of transformers and thermal plant and nearly two-fifths of that of water turbines and two-thirds of the alternators driven by them.

Angle Measuring Oscilloscope

Functional Site Tests on Meters and Relays

By K. RIGBY, A.M.I.E.E.*

The author describes another approach to the problem of proving the correct operation of meters and directional relays on site, as distinct from tests made in testing stations or manufacturers' works. With the aid of the oscilloscope the vector diagram for the meter or relay is obtained under actual operating conditions, the speed at which this can be done minimising the effect of load changes. The vector diagram is then studied to arrive at a determination. The oscilloscope and the method are described and notes are included on interpreting the results

INTEGRATING kWh, kVAh and kVArh meters and directional overcurrent and earth fault relays on three-phase, three-wire high-voltage systems are operated by current and voltage transformers. Whatever separate or combined tests are carried out on the component parts, either at manufacturers' works or meter testing stations, the nature of the equipment is such that functional tests on site, after erection, are necessary.

Basically, meters and directional relays depend for correct operation on the association of a current coil carrying a current of particular phase and a voltage coil across which is applied a particular voltage. In order to prove the correct functioning of the meter or relay equipment on site, it is necessary to examine these currents and voltages to see if they conform to those that should obtain if the equipment is to measure the required quantity.

The angle measuring oscilloscope is used to determine the angular position in degrees of the currents and voltages at the meter or relay terminals. Measurements are made with a pair of test prods across the voltage and current coils so that there is no connecting and disconnecting of the apparatus under test. The complete vector diagram for a three-wire kWh meter can be produced almost as quickly as taking four voltmeter readings. A detailed study of the vector diagram is then made and this, in conjunction with three other easily ascertained facts, can prove that the equipment is functioning correctly or, alternatively, can indicate where the error may be. It is no exaggeration to say that once in possession of this information any imaginable installation or wiring error can be located and corrected at the meter or relay terminals without delving further into the interior of the high-voltage gear. Perhaps I should qualify this statement in respect of metering equipment for tariff purposes for, although this can be made to function correctly, there are certain errors which it is not desirable to correct in this way.

The electrostatic tube in the oscilloscope has four deflecting plates, two for the X axis and two for the Y axis. When two alternating voltages of the same frequency are applied to the X and Y plates simultaneously, the resulting Lissajous figures on the screen can be a circle, an ellipse, or straight lines at 45 deg to the X axis, with either forward or reverse slopes. For use as an angle measuring oscilloscope the X plates are supplied with an alternating voltage, the phase of which can be altered by up to 360 deg or more while the voltage or current under investigation is connected to the Y plates with the test prods as previously described.

Consider now the Ry and By voltages of a kWh meter. With the Ry voltage applied to the Y plates (via attenuator and amplifier) it is possible, by altering the phase of the X plate voltage, to obtain any of the Lissajous figures described above. Let the phase of X be altered so that the straight line with the reverse slope appears. Suppose now the By voltage is applied to the Y plates, an ellipse will appear, but by altering the phase of X once more the straight line with the reverse slope will again be produced. The amount the phase shifting device has to be moved is a measure of the phase difference between Ry and By voltages and if the phase shifter is fitted with a 360 deg scale the precise angular difference is known. The numerical value of the angle is, by itself, unimportant, and, because it is convenient to do so, the Ry voltage is made to come at 0 deg on the scale. Then for a three-wire kWh meter measuring a three-phase unity power factor load the ideal values would be:—

Ry voltage = 0 deg
By voltage = 300 deg
R current = 30 deg
B current = 270 deg

The convention is established that with standard phase rotation adding degrees to a vector will make it lag and subtracting degrees from a vector will make it lead with respect to its original position.

Current Vectors

Voltage vectors are perfectly straightforward and easy to obtain. With current vectors it will be appreciated that what is actually being measured is the voltage developed across the current coil by the passage of current through it. Now a current coil has both resistance and inductance so that this voltage will lead the current by some angle. It is quite simple to determine the angle between the current and voltage of a current coil by passing current through the coil and a resistor in series. The angles of the voltages developed across the resistor and coil are then determined separately, the difference representing the correction factor which has to be added to angular measurements of current taken on site. It is convenient to determine and tabulate the correction factors for various makes and types of meters and relays

* South of Scotland Electricity Board.

so that when making tests on site the correction factor can be applied straightaway. Surprisingly, most kWh meters have a correction factor of 40 deg while reactive meters usually have 14 deg for the compensated type or 40 deg for the cross-connected type. IDMT relays vary between 30 and 60 deg depending on the tap position. Although this may seem to be a large angle to allow for, the fact that it is accurate to one degree or so does not make the final measurement any less accurate. In any case, extreme accuracy is not required to prove correct operation.

A further point is that the voltage developed across a current coil varies from approximately 200 mV at full load on a 5 A coil to 10 mV at one-twentieth load so that the Y amplifier should be designed to obtain a reasonable deflection at voltages of this order. The 110 V voltage coil supplies can be dealt with by a combination of the attenuator and amplifier provided on the oscilloscope. The oscilloscope itself is a standard commercial lightweight type measuring 13½in by 12¼in by 7½in and weighing 18 lb; input 110 V, 33 VA. The screen is 70 mm in diameter; X amplifier sensitivity 140 mV r.m.s. per cm; Y amplifier sensitivity 10 mV r.m.s. per cm.

The phase shifter is a 3in diameter synchro, Selsyn or Magslip rated at 50 V, 50 c/s. The star-connected stator windings are fed from the delta-connected secondaries of three 240/12 V, 24 VA heater transformers, the primaries of which are also connected in delta and operated from the 110 V secondary of the main three-phase or open delta voltage transformer. The oscilloscope power supplies at 110 V are also taken from the main voltage transformer. The variable phase output of the synchro, approximately 6 V, is taken from the rotor via slip-rings to the X amplifier terminals and a 360 deg scale attached to the shaft. The whole assembly of transformers and phase shifter fits into a box 12in by 9in by 5½in and weighs about 5 lb.

Fig. 1 shows the connections required on site. The 110 V, three-phase, three-wire supply to the R, Y, B terminals requires to be standard phase rotation and this should be checked with a phase sequence indicator at the start of the test. The test prods are colour coded so that they may always be applied to the terminals under test in a known manner as a reversal of these leads will show up as a phase shift of 180 deg. The pick-up normally present when the test prods are not actually across a circuit disappears as soon as contact is made.

It should be remembered that the secondaries of current and voltage transformers are earthed at some point and that one of the Y amplifier input terminals may also be normally connected to the oscilloscope chassis which is also earthed. Provided this terminal is always connected via the test prod to the earthy side of the current coil or voltage supply, the test will not be affected. In some cases it may be necessary to operate the chassis free of earth; there will then be only one earth connection and this will be put on the oscilloscope by the Y test prod when it is connected to the meter or relay.

Another precaution is always to take measurements at the terminals of the meter or relay. Not only does this ensure that all wiring between the meter or relay and the v.t. and c.t.'s is included, but it also ensures that the only impedance between the Y test prods when on current is the impedance of the current coil itself. A test taken at the c.t. terminal block, for example, would include the impedance of the connecting leads and any other item of equipment connected in the series current circuit. The add-on angle of 40 deg would not then apply and it would be necessary to connect a small resistance in the circuit to obtain a voltage in phase with the current.

Interpreting the Results

It was said at the beginning that there were three facts which had to be known to arrive at an unassailable verdict. These facts are:—

(1) The direction of phase rotation of the system. This does not mean the phase rotation of that part of the system under immediate investigation but the system as a whole. In this country the phase rotation for distribution systems is standard in the anti-clockwise direction.

(2) The direction of the primary power flow in that part of the system under investigation. For directional relays installed in ring circuits it is necessary to arrange the primary circuits by switching so that the power flow is in a known direction. The same applies on metering installations where power may be exported.

(3) The power factor of the load in the circuit under investigation must be known to within 120 deg.

A voltage transformer (three-phase or open delta) can be so connected on the primary or secondary sides as to produce six different outputs.

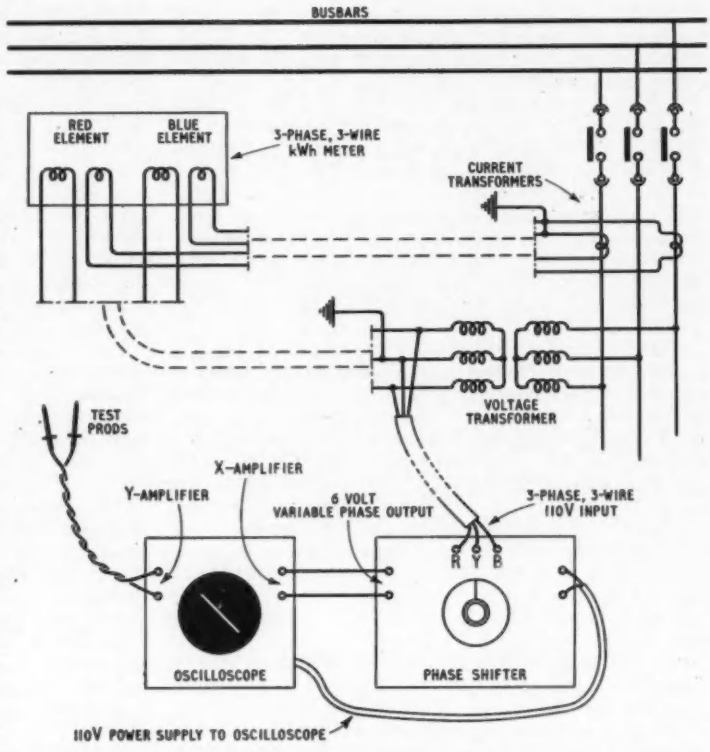


Fig. 1.—Connections between voltage transformer, phase shifter and oscilloscope with diagram of three-phase, three-wire h.v. kWh meter

Imagine three terminals, A, B and C, which are the voltage terminals at the meter panel. Whilst these are nominally R, Y, B they could also be

	A	B	C
1.	R	Y	B
2.	Y	B	R
3.	B	R	Y
4.	R	B	Y
5.	B	Y	R
6.	Y	R	B

Numbers 1, 2, 3 have standard phase rotation.
Numbers 4, 5, 6 are non-standard.
In No. 1 A-B=R-Y and C-B=B-Y.

These are the normal voltages required for a kWh meter. If, because of a wiring or installation error, the voltages are really 2, 3, 4, 5 or 6, then A-B and C-B become as follows:—

2. A-B=Y-B and C-B=R-B
3. A-B=B-R and C-B=Y-R
4. A-B=R-B and C-B=Y-B
5. A-B=B-Y and C-B=R-Y
6. A-B=Y-R and C-B=B-R

A complete 180 deg shift of R-Y to Y-R and B-Y to Y-B cannot be achieved by an incorrect connection external to the v.t., i.e. an installation error. From the table above when A-B equals Y-R, C-B becomes B-R and not Y-B. Similarly, when C-B equals Y-B, A-B becomes R-B and not Y-R. Therefore, if the vector diagram obtained suggests that either all the currents or all the voltages should be moved through 180 deg, it will normally be the currents that are incorrect. It is possible, of course, that the internal connections of the v.t. are wrong by 180 deg, i.e. a manufacturing error, but if this is the case, moving all the currents through 180 deg will still put matters right.

In cases 2 and 3, the rotation is correct, but the A-B and C-B voltages are stepped forward or backward by 120 deg. If the current circuits are correct, there are then two conditions of load for which correct vector diagrams would be obtained. The power factor of the two loads would differ by the amount the voltages are stepped forward or backward. Only one condition can be applicable to a particular installation and this is why the power factor of the load must be known to within 120 deg. This almost amounts to deciding whether the load is leading or lagging.

Current transformers can be so connected on the primary or secondary sides as to produce two outputs, each differing in phase by 180 deg. If both the currents on a metering installation are 180 deg out, this is apparent, but if one is wrong, one correct, this has the effect of reversing the phase rotation of the current vectors. Also the angle between the vectors is reduced to 60 deg instead of the customary 120 deg. Serious unbalance of load can also cause an alteration in the angle between current vectors, the limits of this under the most extreme conditions being 0 to 180 deg. It is very unusual to find this, but it is as well to bear it in mind. These difficulties can be overcome when encountered by adding the red and blue currents in a 5+5/5 summation current transformer to produce a yellow current which enables a determination to be made. In this respect, directional relay installations are much easier as a yellow current is provided to enable the earth fault relay to be residually connected. The theory behind all this is that the RYB currents should summate to zero.

Although wiring and installation errors may be corrected at the meter or relay terminals, it is not suggested that this should be done as a matter of course. It is inexcusable that switchgear should be connected with non-standard phase rotation on the primary side or that v.t.'s and c.t.'s should be installed in the wrong phases. When an error is discovered it should be corrected at the source, not corrected by making a second error farther along the line. This particularly applies to tariff metering where, for example, an installation may be correct except for a phase rotation error on the primary side. If this error is corrected at the meter terminals, the meter, although functioning correctly, may not be working in the exact manner for which the percentage errors of registration were found. This boils down to red c.t. supplying blue element and blue c.t. supplying red element when the primary rotation is BYR instead of RYB, and this is corrected at the meter or relay terminals, instead of on the primary side.

Under certain conditions when neither the voltage vectors nor the current vectors appear to be correct, it is obviously necessary to have some definite information from which to proceed so that the error may be corrected at the source. When confronted with this situation, it is probably quicker to make certain of the current vectors by carrying out a primary injection test to prove that red c.t. is in red phase, yellow c.t. in yellow phase, etc. This is done by injecting into one phase at a time, or where only two c.t.'s are involved, it can be done by injecting red to blue to get two secondary currents; red to yellow to get one secondary current; blue to yellow to get one secondary current. This definitely fixes the c.t.'s and the rest of the installation is then brought into line.

Directional Relays

Directional overcurrent relays do not require any special preparation before test except to arrange the direction of power flow. When the primary load is low, measurements and deductions can be made on the directional elements of these relays using the oscilloscope, without the relay disc itself moving. This is a rather novel feature and has advantages when commissioning new gear where, for instance, the connected load may be small.

Directional earth fault relays require much more preparation. It is necessary to prove correct operation on simulated earth faults. For a red phase earth fault this consists of removing the red h.v. fuse from the v.t. and shorting-out the red phase to neutral secondary winding. The v.t. is then energised with yellow and blue voltages to earth. Similarly, the yellow and blue c.t.'s are shorted-out so that only the red c.t. drives current through the earth fault relay. Under these conditions the vectors of the voltage and current on the relay may be determined with the angle measuring oscilloscope as before, even when the directional disc refuses to move because the load is too light.

Now for a word on harmonics. The net result of harmonic-producing current using apparatus on the supply system, in general, is small, and measurements on distribution feeders are only slightly affected by harmonics. On the other hand, the current wave of the supply to a single consumer with, say, a large rectifier load, may be severely distorted and this, of course, is reflected in the output of the current transformer. This introduces additional frequencies at the Y plates of the cathode-ray tube and distorts the straight line which is the product of two equal frequencies. It is always possible, however, to tune the picture for minimum area in the reverse slope direction and so obtain acceptable and reliable results.

TEST RESULTS

No. 1. Three-phase, three-wire kWh meter. Correction factor 40 deg on current.

R – Y = 0 deg.
B – Y = 301 deg.
RI = 20 + 40 = 60 deg.
BI = 264 + 40 = 304 deg.

Note. B – Y volts lag R – Y volts by 301 deg and BI lags RI by 244 deg. Also, RI lags R – Y volts by 60 deg which equals a power factor of 30 deg lag and BI lags B – Y volts by 3 deg which equals a power factor of 33 deg lag. This installation is correct. Figures taken from the kVArh meter compensated type on the same installation are:—

R – Y = 0 deg.
B – Y = 301 deg.
RI = 53 + 14 = 67 deg.
BI = 299 + 14 = 313 deg.

No. 2. Three-phase, three-wire kWh meter. Correction factor 40 deg.

R – Y volts = 0 deg
B – Y volts = 300 deg.
RI = 243 + 40 = 283 deg.
BI = 131 + 40 = 171 deg.

This was a 30/5 A, 11,000/110 V metering installation on a 500 kVA transformer. The above figures were determined on transformer magnetising currents, i.e. at no load when the meter disc was barely moving. It was concluded that both currents required to be moved through 180 deg as this gave power factors of 73 deg lag on red element and 81 deg lag on blue element, which was to be expected for an unloaded transformer. During examination to correct the error at the source, it was discovered that additional wiring errors had been made at the switchgear terminal block, with the result that the red and blue position of currents and voltages appeared to be transposed. If these were to be corrected, the phase rotation at the meter end would be reversed, so a primary injection test was then made to fix the position of the c.t.'s. This confirmed the transposition of the red and blue secondaries at the block. The voltage connections at the block, therefore, also had to be transposed, which made it seem likely that the phase rotation of the primary conductors was incorrect. This turned out to be the case and it was found necessary to re-make the cable termination of the incoming feeder.

The angle measuring oscilloscope has turned out to be a most versatile test instrument and when used in the manner described provides a convincing answer to the problem of proving meter and relay installations on site.

International Congress on Electro-Heat

THE fourth International Congress on Electro-Heat will be held at Stresa, Italy, from 25th to 29th May, when nineteen papers by British authors are to be presented. Altogether 199 papers will be given to the ten sections into which the Congress will be divided. The number of delegates notified at the end of 1958 was 580, of whom 39 are British. The following are the titles of the British papers to be presented:—

"Electricity in the Pottery Industry," by Messrs. H. A. P. Caddell, M.A., M.I.E.E., and S. Scholefield, A.M.I.E.E. (Midlands Electricity Board); "Selling Electro-Heat," by Mr. H. Jackson, B.Sc., M.I.E.E., M.I.Mech.E. (South Wales Electricity Board); "Development of Electric Radiant Heating Tubes," by Mr. L. W. Webb (Birlec, Ltd.); "Development of Electric Smelting in the British Commonwealth," by Mr. A. G. Robiette, D.Sc., F.I.M. (Birlec, Ltd.); "Electric Surface Heating for Industry," by Mr. H. Reik, M.Sc.(Eng.), M.I.E.E., M.I.Mech.E. (Isopad, Ltd.); "Electro-Heat in the Fabrication of Aluminium," by Mr. A. J. Jones, B.Sc.(Eng.), A.M.I.E.E. (Northern Aluminium Co., Ltd.); "The Control of Large Electric Arc Furnaces in Relation to their Effect on the Supply System," by Mr. J. W. S. Payne, B.Sc. (British Thomson-Houston Co., Ltd.); "Vacuum Induction Melting and Casting," by Mr. F. L. Gladwin (Wild-Barfield Electric Furnaces, Ltd.); "Induction Melting Furnaces," by Mr. A. G. Allen (Birlec, Ltd.); "Radio Frequency Heating as Applied to the Wood Industry," by Mr. J. Pound (Pye, Ltd.); "Some Observations on the Design and Operation of an All-Electric Glass Melting Furnace," by Mr. P. A. M. Gell (Elemelt, Ltd.); "High Speed Cinematography of Sustained Power Arcs," by Mr. J. C. Needham, B.Sc. (Electrical Research Association); "Industrial Storage Space Heating," by Mr. J. W. Moule, B.Sc.(Eng.), M.I.E.E. (South of Scotland Electricity Board); "Interstage Annealing with M.F. Induction Heating," by Mr. K. A. Zandstra, A.M.I.E.E. (Philips Electrical, Ltd.); "Developments in Resistance-Heated Vacuum Furnaces," by Mr. M. Donovan (General Electric Co., Ltd.); "Applications of Infra-Red Heating in the Plastics, Rubber and Textile Industries," by Mr. G. M. Hogarth (General Electric Co., Ltd.); "Electricity Supplies to Large Electric Arc Furnaces; Some Technical and Economic Considerations," by Mr. A. Haddock, B.Sc., M.I.E.E. (Yorkshire Electricity Board); "Electrode Boilers for Industrial Electric Heating," by Mr. S. A. Williams, A.M.I.H.V.E. (Bastian & Allen, Ltd.); "A Mains Frequency Induction Holding Furnace for Gravity and Low Pressure Die Casting," by Messrs. M. Gibbs and R. H. Barfield (Wild-Barfield Electric Furnaces, Ltd.) and Mr. E. C. Lewis (Alumasc, Ltd.).

Further information regarding the Congress and delegates' registration forms can be obtained from the Secretary, the British National Committee on Electro-Heat, 2, Savoy Hill, London, W.C.2. In order to obtain accommodation in Stresa registration forms should be returned not later than 25th February. The Congress fee is 40,000 lire (about £23) which does not include hotel accommodation or travelling.

The British National Committee on Electro-Heat was reorganised about a year ago and its members now are:—British Electrical and Allied Manufacturers' Association; British Electrical Development Association; British Iron and Steel Research Association; British Non-Ferrous Metals Research Association; Department of Scientific and Industrial Research; Electrical Research Association; Electricity Supply Industry (through the Electricity Council, Electricity Boards and the South of Scotland Electricity Board); Institute of Metals; Institution of Electricial Engineers; and the Iron and Steel Institute.

Transistor Convention

IT is announced by the Institution of Electrical Engineers that Lord Hailsham, Lord President of the Council, has accepted an invitation to deliver the opening address at the international convention on transistors and associated semiconductor devices which is to be held at Earls Court during May.

GEO-ELECTRIC SURVEYS

IN a paper presented before the Institution of Electrical Engineers' Measurements Section on 3rd February, Professor L. S. Palmer (Hull University) included a formula for arriving at the apparent resistivity of the earth's crust at different depths below the surface with increased spread of the current electrodes. The underlying principle was that published by Wenner in 1916, in which a current was sent into the earth through two electrodes, C_1 and C_2, the potential fall being measured between a second pair of electrodes P_1 and P_2. The four electrodes were equally spaced along a straight line bisected by the point on the surface below which the measurements were required. The resistivity $=2\pi dR$ ohm-ft, where d represented feet and R the ratio of potential fall (in volts) to the circulating current.

In the author's modification the electrodes, instead of being equidistant, are arranged so that the ratio is kept constant; the resistivity then equals $\frac{\pi(1-\alpha^2)}{2\alpha}$ aR ohm-ft, where α is the above ratio and is less than unity, a is $C_1C_2/2$ft and R is the ratio in ohms of input voltage to output current. The ability to choose different values of α for different sets of readings imparts flexibility to the new method; the greater its value the greater is the measured potential and the same instrument can be used with equal accuracy, irrespective of the resistance of the subsoil and irregularities on the surface. Variations in resistivity below the station would produce curves from which the type of anomaly and its depth could be determined. Three anomalies were exemplified in detail. In many cases comparisons were possible between these graphs and bore-hole data or measurements based upon subsequent excavations.

Interference from earth currents and contact potentials would prevent reliable results when a battery-operated circuit was connected across the current electrodes and a voltmeter across the potential electrodes. A method illustrated in Fig. 1 was described which entailed the use of a manually operated two-winding d.c. generator and a voltmeter which was calibrated in ohms by keeping the current constant in winding N_1 by means of an adjustable resistor R. S_1 and S_2 are mechanically operated low-frequency reversing switches. The resulting low-frequency potential generated between P_1 and P_2 is commutated by reversing switches S_3 and S_4, so that d.c. passes through the galvanometer G_1. The circuit is protected by condensers from direct earth currents and from potentials set up at the electrode-earth contacts. The d.c. from the winding N_2 passes through a potentiometer (P) in opposition to the d.c. from the potential electrodes. Adjustment of the potentiometer slider enables galvanometer G_2 to function as a null-recording instrument. The requisite back-current passes through the deflector coil C of galvanometer G_2, the controlling field of which is provided by the constant current in the coil C. Thus the deflection of the needle will be proportional to the current through D, i.e. to the potential generated across P_1P_2. Since this current is constant, the deflection can be calibrated in ohms; hence G_2 functions as an ohmmeter. The low-frequency reversing and commutating switches, which are controlled by the revolutions of the manually operated handle of the generator, overcome troubles due to earth currents and contact potentials without introducing the reactance and phase difficulties associated with a.c. bridge methods. A slide rule has been designed from which the resistivity can be read directly with only one adjustment of the slide.

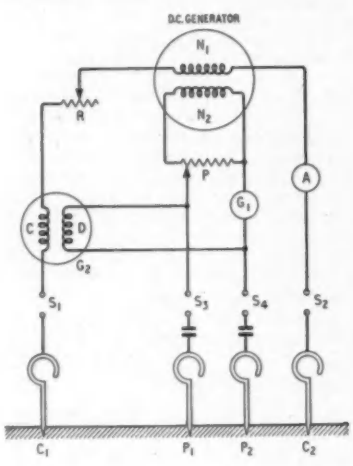


Fig. 1.—Simplified circuit of electrical equipment devised for geo-electric surveys

National Inspection Council

IN its seventh progress report, covering the last quarter of 1958, the National Inspection Council for Electrical Installation Contracting shows that in that period 54 further applications for entry in the Roll of Approved Electrical Installation Contractors were received. The Council approved 64 applications for enrolment; 52 applications were deferred for further inspections; three were rejected; and 59 firms were removed from the Roll, mainly because they had gone out of business or had given up installation contracting.

At a meeting of the Scottish Committee in November, under the chairmanship of Mr. J. Gogan, a clause in the Building (Scotland) Bill requiring a certificate from the electrical contractor that the installation complied with the building authority's requirements was welcomed as a step in the right direction. It was agreed that this would call for close contact between the Scottish Committee of the N.I.C. and the proposed Building Standards Advisory Committee in Scotland.

The report notes the publicity given by the Press to the work of the Council and records successful meetings at Newcastle (chairman, Mr. Vernon Ferens), Birmingham (Mr. J. A. Crabtree) and Luton (Mr. A. F. Plummer, chairman of the Council). It is hoped to start a series of meetings especially for architects with the help of Mr. T. Mitchell, the R.I.B.A. representative on the Board.

A list has been started of local authorities, consulting engineers, architects, builders and large industrial concerns who restrict invitations to tender for electrical work to approved contractors. So far the list, which is acknowledged to be incomplete, includes 22 local authorities and ten consulting engineers, architects, etc.

During the quarter 1,700 individual installations were examined, bringing the total to 14,355 since 1st January, 1957. There seems to have been a raising of the level; about 79 per cent of the work examined has been well up to the required standard. There has been a steady decrease in the number of contractors who do not possess a copy of the I.E.E. Regulations and/or suitable earth continuity testing equipment. The inspecting engineers met in December to give further consideration to the co-ordination and standardisation of inspections.

VIEWS on the NEWS

By REFLECTOR

ON the surface (if I may use a rather inappropriate term) the statement by the Minister of Transport holding out no hope that the proposed Victoria tube railway will ever be constructed may seem quite reasonable. The work would cost £55 million and the receipts would be insufficient to meet the charges. London Transport's finances are already in a precarious state so that this added burden would be intolerable. The scheme could be carried out only on the basis that as a contribution to the easing of London's traffic pressure it should be regarded as an all-London matter and the loss should be shared between the local authorities concerned and perhaps the national Exchequer. On the whole this might be better than spending the money, as Mr. Brooke hinted, on "off-street parking or other matters."

* * *

Continuing my story of the Romney Marsh swans who have been causing such trouble to the South Eastern Electricity Board, I have to report that there is a possibility that some of these birds may be deported to another area. The owner of a lake in the Chilterns has offered them a home. His letter was sent to the Lydd Town Council who passed it on to the New Romney Town Council who appear to have referred it to the Home Office, no doubt for adequate reasons. If the invitation is accepted it should not be before the Eastern Electricity Board has expressed its opinion.

* * *

About four months ago I commented on the final stage in the winding-up of the Giant's Causeway, Portrush & Bush Valley Railway & Tramway Co., Northern Ireland, whose undertaking was sometimes claimed to be the oldest electric tramway in the British Isles. But an even older line was in the news last week—the Oystermouth (Swansea) and Mumbles Railway. This was the subject of a Private Act of 1804 and was electrified at a later date. Provision is included in the South Wales Transport Bill for the closing of the railway but when the Bill went before the House of Lords for second reading several noble lords protested. Lord Merrivale said that the evil-smelling transport that replaced electric traction did not always give the public complete satisfaction. Lord Silkin also thought that the line should be preserved. As a result of the opposition to the clause the second reading debate was postponed until 17th February.

* * *

In the course of his distinguished career Dr. P. Dunsheath has had many honours bestowed upon him but I did not know until I read the February *B.S.I. News* that he had been awarded by the Soviet Government the title of "Advanced Worker in Power Stations (Order of Lenin)." This was "revealed" by Col. B. H. Leeson when, at a recent meeting of the British National Committee of the International Electrotechnical Commission, he presented Dr. Dunsheath with a gold pencil on behalf of the Committee to commemorate Dr. Dunsheath's presidency of the I.E.C. during 1955-58.

* * *

Radio documentary stories devoted to electrical engineering are comparatively rare and I was therefore interested to listen to "Breakdown" last week, one of the B.B.C.'s "Our Day and Age" series. This dealt with the work of the Eastern Electricity Board and, in particular, the experiences of one of their engineers from Harwich in maintaining supplies during the extensive floods which inundated the coastal areas of East Anglia in 1953. Although electrical engineering, or for that matter any form of engineering, is somewhat difficult to dramatise I feel that the B.B.C., and their script writer Mr. Stephen Grenfell, are to be congratulated on this programme. I particularly liked the emphasis placed on the extraordinary activities involved in providing a service which is always taken for granted.

* * *

Introducing a report upon a visit to the Berkeley (Glos.), nuclear power station, the *Manchester Guardian* says:—

> "Even those amenity interests who object to the appearance of atomic power stations would agree that the view from the top of one (if they were ever allowed to see it) is something well worth having."

This reminds me of the man who said that if he had to live in Paris he would stay on the Eiffel Tower as that was the only place from which one could not see that awful structure.

* * *

Some queer advertisements were appearing in the *Electrical Review* eighty years ago. For example, in the issue of 15th February, 1879, there was one for the "Galvanophone or Electric Songster," "invented by one of the most eminent electricians of the day." No explanation of the operation of this device was given but it seems to have been a microphone. The equipment included the "galvanophone" itself, a transmitter of polished boxwood, a "powerful" bichromate battery, a sound magnifier and an insulated line wire. Some uses were suggested:—

> "The galvanophone sings out the song fifty times louder, causing either the greatest consternation or wonder for it may be secreted on or under a table, or—'horror of horrors!'—in grandmother's bed, and the apparatus suddenly worked without any previous warning. . . . Enterprising tradesmen will find it a splendid advertisement for, fixed over the shop door, it can be heard for a quarter of a mile, although the boy upstairs is only humming a song into the transmitter."

On the whole, it seems to have been a most diabolical device.

I.E.S. JUBILEE BANQUET

Advance in the Art of Illumination

THE arts, science, industry and the church were represented at the Golden Jubilee Banquet of the Illuminating Engineering Society at the Criterion Restaurant, London, on Monday last, 9th February. In honour of the occasion the speeches were relayed by G.P.O. line and radio link to the thirteen centres of the Society throughout Britain and also to the centre in Johannesburg.

It was fitting that the Criterion should have been chosen as the venue for this important occasion for, as the Very Reverend A. C. Don, Dean of Westminster, pointed out in proposing the toast of the Society, it was there, in February, 1909, that the Society was begotten. The Dean went on to say that illumination had made rapid strides since the war and the large number of new churches had provided architects and engineers with the chance of demonstrating what could be done. Our ancient churches presented a much more complicated and difficult problem. Gloucester Cathedral had recently been scientifically re-lit with admirable results. He said he would have to leave it to his successors to see what could be done in this respect in Westminster Abbey. The present lighting was highly unsatisfactory and inartistic. Within a few years the cleaning of the interior stonework would be completed and lighting was a problem which would then have to be tackled.

Responding to the toast, the president of the Society, Mr. C. C. Smith, said that at the inaugural meeting of the Society fifty years ago there were 26 present; at the banquet there were 450 in person, while a further 1,500 were with them in spirit. They ranged from as far afield as South Africa and the north of Scotland. They were linked physically by G.P.O. lines and culturally by a common desire to acquire and share knowledge of lighting. Referring to the lighting of churches Mr. Smith said that it was one of their many activities; it was small but important, gratifying and satisfying.

The Society's aims were two-fold: to bring about a genuine recognition of the need for good light in all walks of life, and to determine, by means of experiment and discussion, what the essentials of good lighting really were. To do this they must endeavour to encourage everyone concerned to co-operate.

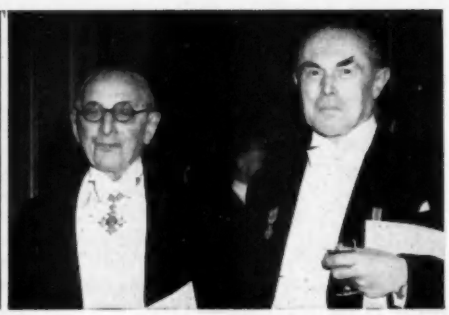
Mr. Smith thought this could best be done at meetings of the Society where all present were encouraged to criticise and offer solutions to the many lighting problems confronting us today.

Dr. G. B. B. M. Sutherland, director of the National Physical Laboratory, proposed the toast to "Science." He pointed out that we knew little about the mechanism by which certain animals produced light or how some plants were efficient in converting energy of sunlight into chemical energy. If we could understand that, then perhaps we could reverse it. "What a boon it would be if tarmac were able to absorb such energy and emit it at night!" He suggested that in science a little learning was not a dangerous thing. Science should be an integral part of our general intellectual heritage, and anyone capable of passing the eleven-plus examination could be taught to appreciate most of the basic concepts underlining science.

Mr. J. W. T. Walsh, the Earl of Mount Edgcumbe and Sir Charles Wheeler

Sir Charles Wheeler, President of the Royal Academy of Arts, in proposing the toast to "Art" said that artists were particularly dependent upon light for the execution of their daily tasks. They might know nothing of the mechanics of light, but they knew of its value and meaning in the world of visual reality which was their domain. You could not make a picture without light. Colours were the progeny of light and Sir Charles thought that

Left: Messrs. C. C. Smith (President), A. H. Ensor and D. Bellamy and the Mayor of Westminster (Cllr. D. Cobbold). Right: Dr. R. Lessing and Mr. H. C. Weston



Left: Dr. G. B. B. M. Sutherland and Mr. L. J. Davies. Right: Messrs. A. E. Iliffe and Leslie Gamage

we were not grateful enough for colour. The artist and the illuminating engineer had the most marvellous material in their hands.

When he proposed the toast to "Industry," Mr. Leslie Gamage, chairman of the General Electric Co., Ltd., said that no matter what might be claimed for other British industries, the British lighting industry led the world. It was the industry's partnership with art and science which had given us that world leadership. Referring to the simplicity of lighting, he said it was only too easy to take it for granted. But such progress did not happen on its own. Let us not forget that it was in the research laboratories and factories of industry that the techniques and equipments used today were evolved. If industry had been content to concentrate on producing the "hardware" of lighting and had not shown initiative and confidence in research, illuminating engineering as we knew it would never have existed.

Development work of this kind necessitated a considerable financial outlay. If industry was to carry out extensive research and support organisations such as the Illuminating Engineering Society, then it must be allowed to make profits which rendered such things possible. The idea that price was the only criterion was a snare and delusion and would defeat its own object.

The toast of the guests was proposed by Dr. J. W. T. Walsh, president of the International Commission on Illumination, and a brief response was made by Councillor David Cobbold, Mayor of the City of Westminster.

Electrical Development in Trinidad

AN interesting section of the latest annual report received from Mr. K. W. Finch, M.I.E.E., general manager of the Trinidad and Tobago Electricity Commission, relates to new electrical applications in agriculture. An all-electric dryer just introduced commercially, for instance, is said to have revolutionised the processing of cacao beans which it polishes as well as dries. The equipment consists of a cylindrical tank, the "activator-polisher" dryer and an open tray type dryer. Air is supplied by an electrically driven blower and warmed by heating elements. The area occupied is only 8½ per cent of that required for drying-floors, costs are less and the quality of the beans is considered to be superior to that of sun-dried beans. The equipment can also be used for drying coffee, in which case only the cylindrical tank is used.

In the rice milling industry the change-over from diesel plant to electric drive has been retarded by difficulty in obtaining single-phase motors from stock. This matter was taken up with the Electrical Retailers' Association and supplies of these motors are now more readily available.

During 1957 the Commission generated 148 million kWh, 10 per cent more than in the previous year. Sales totalled 130·9 million kWh, industrial consumption rising by 8·75 per cent, commercial by 12·6 per cent, general lighting by 16·7 per cent, domestic by 17·5 per cent and street lighting by 29·5 per cent. The number of consumers connected at 31st December, 1957, was 39,699, a net increase of 5,130.

The erection of a C. A. Parsons 20 MW turbo-generator, with Babcock & Wilcox boiler, at the Penal power station was completed during the year and the set was put into service.

Revenue for the year amounted to $5·2 million, there being a net operating deficit of $201,972. Gross capital expenditure in 1957 totalled nearly $5 million ($4·80=£1).

Documents on European Free Trade

IN a White Paper published recently the Government reaffirm their belief in the overriding importance for the future of Europe of finding a multilateral solution which will provide for freedom of trade, including the removal of tariffs and quantitative restrictions, among members of O.E.E.C. The Government also believes that though outstanding points are of "considerable significance" they are not incapable of solution by "further negotiation in an atmosphere of common determination to succeed and agreement on the ultimate object."

The White Paper (Cmnd. 648, price 9d), which gives the Government's report on the course of negotiations up to December, 1958, also sets out the Government's present attitude on the fundamental issues, namely external tariffs and commercial policy, internal economic and social policies, and institutional arrangements, on which agreement has not been reached. It is accompanied by a Blue Book (Cmnd. 641, price 10s 6d) of 237 pages containing the supporting documents. These include the resolutions of the council of the O.E.E.C., and the reports and other papers of the various committees, working parties, expert groups and steering boards concerned in the discussions. There is a progress report of nearly thirty pages by the O.E.E.C. staff and various notes and proposals, including a substantial group on agriculture, submitted by individual countries, the European Economic Community and European Payments Union.

NEW RESEARCH REACTOR

A NEW low-power research reactor is to be built at Windscale, which is being expanded as one of the national centres for the development of gas-cooled reactors. It will be known as "Hero," a name derived from its description as a hot experimental reactor of 0 (zero) power. The cost will be about £1,250,000, and the reactor will be built near the advanced gas-cooled reactor (A.G.R.) on which work has already started. Its function will be to complement the work of A.G.R. by making it possible to carry out low radiation level measurements and to experiment with several alternative arrangements of fuel to obtain the best results. "Hero," which will generate a few kilowatts of heat, will consist initially of a graphite structure 19ft in diameter and 19ft high. But an important feature is that it will be possible to dismantle it and rebuild it in a variety of ways. The fuel will consist, as in A.G.R., of clusters of pencil-like rods of uranium oxide sealed in beryllium cans, and these will be arranged in channels in the graphite on a regular lattice.

It is expected that from about 1965 onwards the reactors for nuclear power stations will be based on A.G.R. using uranium oxide fuel and beryllium instead of magnesium cans. This will permit higher operating temperatures and heat ratings and lead to greater efficiency than in the reactors currently being built for the electricity authorities. The levels of radiation inside the reactors will be considerably higher.

The most important material problem is to develop fuel elements which can withstand high burn-up under the exacting conditions of high temperature and high flux, and the main purpose of the A.G.R. prototype is to test various types of fuels under full reactor conditions.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Council of the Institution of Electrical Engineers has elected **Mr. C. W. Speirs,** J.P., F.Inst.P., F.C.G.I., M.I.E.E., to honorary membership of the Institution in recognition of his contributions to the advancement of electrical science and engineering, his notable services in these fields and of his outstanding support for the work of the Institution, particularly of its Incorporated Benevolent Fund. The Council has also made the thirty-seventh award of the Faraday Medal to **Signor Luigi Emanueli** for his outstanding contribution of inventions and new applications in the field of electric cables and particularly for the invention of the oil-filled cable.

Mr. C. W. Speirs

Mr. Speirs was born at Haltwhistle, Northumberland, in 1873. He was educated at St. Bees Grammar School and matriculated at Glasgow University, at first with the object of taking up medicine. He subsequently took classes at the University of Durham and in 1891 entered the works of C. A. Parsons & Co., Ltd., Heaton, as an engineering apprentice. From 1893 to 1895 he studied at the Central Technical College, entering as a second-year student. In 1898 he joined the Morgan Crucible Co., Ltd., as engineer and technical adviser, remaining with this organisation until his retirement in 1933.

Signor L. Emanueli

He was elected to the Surrey County Council in 1934, and in 1936 was chosen as the first Mayor of Malden. He is a founder fellow of the Institute of Physics and joined the I.E.E. in 1897 as an associate. Always a firm supporter of the activities of the Incorporated Benevolent Fund of the Institution, Mr. Speirs in 1944 made a substantial gift of land from his estate at Malden, accompanied by a notable endowment. These gifts, supplemented by the contributions of members to the "Homes Fund," brought into being "The Chesters Estate." The portrait reproduced with these notes is from a painting by Bainbridge Copnall.

Signor Emanueli was born in Milan in 1883. He graduated in electrical engineering from the Milan Polytechnic in 1906. He is vice-president of the Pirelli Co., of Milan, where he started his professional life in 1907, and is also a director of Pirelli-General Cable Works, Ltd., Southampton. He was elected a member of the Institution in 1922. Signor Emanueli's name is linked with numerous scientific inventions and applications in the electric cable and the rubber industries, including the oil-filled cable, which represented a turning point in technical progress in this field.

Mr. C. S. F. Lane has been appointed regional manager for Australia and New Zealand in the overseas organisation in London of British Insulated Callender's Cables, Ltd. He succeeds **Mr. R. H. Semple,** who has taken up a senior executive post with an associate company in Australia.

Mr. C. S. F. Lane

Mr. Lane joined Callender's Cable & Construction Co. at its Erith Works in 1932 and in 1942 he transferred to the research staff at the Wood Lane laboratories. After nine years in the research organisation Mr. Lane joined the sales organisation and was later appointed sales manager, supertension cables. Since 1951 he has travelled extensively in many parts of the world and has been associated with many of the major B.I.C.C. overseas contracts.

Sir Ben Barrett has been appointed to the board of Pye, Ltd.

Mr. S. E. Goodall, M.Sc., F.Q.M.C., M.I.E.E., director and chief engineer of W. T. Henley's Telegraph Works Co., Ltd., and President of the Institution of Electrical Engineers, presented the awards and prizes at the **North West Kent College of Technology,** Dartford, on 3rd February. In his address to the students, Mr. Goodall stressed the importance of co-operation between industry and technical colleges.

The Eastern Electricity Board has appointed **Mr. W. S. Kelly,** B.Sc., at present engineer to the Norfolk Sub-Area of the Board, as the purchasing officer in succession to **Mr. H. J. Aylott,** who is retiring. Mr. Kelly, who lives at Hopton-on-Sea, between Great Yarmouth and Lowestoft, will shortly move to Ipswich to take up his new appointment. He was educated at Bellahouston Academy and at Glasgow University where he obtained first-class honours in electrical engineering. After a short period with the MacFarlane engineering concern in Glasgow he became a charge engineer with the Glasgow Corporation Transport Department. He was next with William Goodfellow & Co., electrical contractors, Glasgow, and then (in 1931) went to Dumfries as an assistant district engineer to the County Council. He subsequently held appointments with the Dundee and Greenock Corporations and in 1945 he became deputy electrical engineer and manager at Great Yarmouth. On nationalisation he was appointed the Norfolk sub-area engineer.

Mr. W. S. Kelly

Mr. R. W. Hankinson has been appointed London technical representative of Bill Switchgear, Ltd. He will operate from the company's London area office, 38-40, Gillingham Street, London, S.W.1. Before joining Bill Switchgear, Ltd., Mr. Hankinson was with Holliday, Hall & Stinson, Ltd., J. H. Plant, Ltd., Cable Jointers, Ltd., and latterly Ionlite, Ltd. He is hon. secretary of the South West London Branch of the A.S.E.E.

Mr. A. J. Gibbons, B.Sc.Tech., M.I.Mech.E., M.I.E.E., is resigning his position of plant and equipment design engineer, Transmission Design Branch, Chief Engineer's Department, C.E.G.B., at the end of March and is joining the board of the Yorkshire Electric Transformer Co., Ltd., in April as technical sales director. He received his technical education at Manchester University (College of Technology), and after service with the Gloucester Regiment in the 1914-18 war was with the Metropolitan-Vickers Electrical Co., Ltd., and the Manchester Corporation Electricity Department. In 1927 he joined the London Power Co., with whom he became assistant chief electrical engineer in 1938, a position he held until the nationalisation of the

Mr. A. J. Gibbons

industry when he took up the position of plant and equipment design engineer from which he is now resigning.

As technical sales director of the Yorkshire Electric Transformer Co., he will be responsible for all aspects of the company's business in the South of England, including the Midlands and South Wales. His address is 3, Orchard Rise, Coombe Lane, Kingston - on - Thames (telephone: Malden 6263).

Mr. D. R. Barrett has been appointed a director of Kent Bros. Electric Wire Co. & E. H. Phillips, Ltd. Mr. Barrett joined the company as a sales representative in 1946 and was appointed to the position of sales manager in 1957.

Mr. N. T. Evans, A.M.I.E.E., is relinquishing his position of senior contracts engineer with the Colston Electrical Co., Ltd., on 2nd March to join a new concern in Bristol, Scull Electrical, Ltd., as contracts engineer. Mr. Evans was educated at Bromyard Grammar School, Herefordshire, and on moving to Bristol received his technical education at the Merchant Venturers' Technical College in that city. He was apprenticed with the Colston Electrical Co. and has been with the company for some twenty-three years.

Mr. W. Johnstone has been appointed sales manager of Nettle Accessories, Ltd. He will operate from the sales division head office at Warren Street, Stockport (telephone: Stockport 7155).

The annual dinner of the South Midland Centre of the **Institution of Electrical Engineers** was held at the Grand Hotel, Birmingham, on Friday last, under the chairmanship of Mr. J. Ashmore. On every place at the table was an envelope in which those present were invited to put a donation towards the I.E.E. Benevolent Fund. This realised nearly £100.

Proposing a toast to the Institution, the Lord Mayor of Birmingham (Alderman Donald Johnstone) said that many modern industrial and technological advances had been made possible through the development of electrical and electronic techniques. Furthermore, automation, as it was popularly known, would not have been possible had it not been for the efforts of electrical engineers. The response was made by Mr. S. E. Goodall, President of the I.E.E., who began by announcing the decision at a Council meeting on the previous day to change the name of the Radio and Telecommunication Section to the Electronics and Communications Section. Referring to the new Dip.Tech.(Eng.) course, he said that he was encouraged to learn that Birmingham was the first college recognised to run these courses and they had now awarded the first of the diplomas. The President then mentioned the training of technologists and said that the system proposed by the I.E.E. was meeting with great success. The leading manufacturers were playing their part in the scheme but, because of the great demand for men, the smaller and more specialised firms should be persuaded to join in and make their contribution. Possibly these smaller firms could form groups to assist the colleges.

A toast to guests and kindred associations was proposed by Mr. J. Ashmore and an amusing reply was made by Judge Arthur Forbes.

Mrs. E. L. Wildy, wife of the chairman and managing director of the **London Electric Wire Co. & Smiths, Ltd.,** and its associate companies, formally opened new branch premises at 66-74, Brown Street, Glasgow, C.2, on 21st January. Many Scottish customers and friends attended the ceremony.

Mr. E. L. Wildy (seated), with Mrs. Wildy on his right, with guests at the opening of the new L.E.W. Scottish branch premises

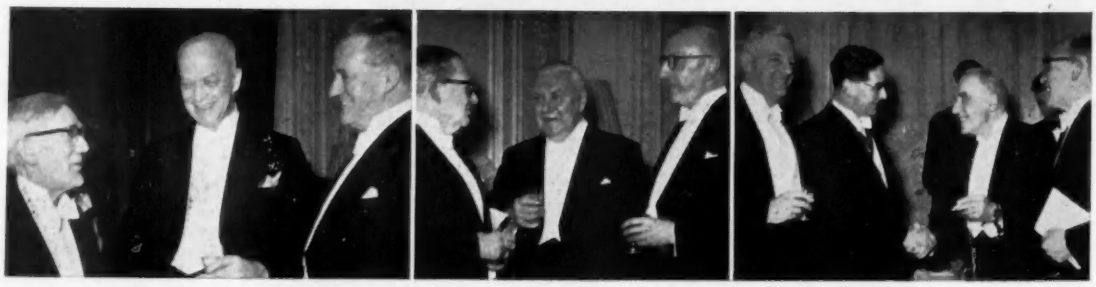
Mr. E. J. Vidler, Companion I.E.E., director and general manager of W. T. Henley's Telegraph Works Co., Ltd., has been elected chairman of the Cable Makers' Association.

Mr. E. J. Vidler

Mr. Vidler joined Henley's in 1918. He was appointed assistant sales manager in 1937, and sales manager in 1946. In 1950 he became assistant general manager and, in 1954, general manager. He joined the board in 1955. Mr. Vidler is also a director of Southern United Telephones, Ltd.

The annual dinner of the **Ipswich and District Electrical Association** took place at the Great White Horse Hotel, Ipswich, on 6th February. Mr. A. White (chairman) presided and

Left: Messrs. C. F. Partridge (chairman, Education Discussion Circle, South Midlands Centre), J. J. Gracie (General Electric Co., Ltd.) and R. L. Batley (regional director, Midlands and East Midlands Region, C.E.G.B.). Centre: Messrs. W. K. Brasher (secretary, I.E.E.), J. Ashmore (chairman, South Midlands Centre) and S. E. Goodall (president, I.E.E.). Right: Mr. J. E. Jones (chairman, Institution of Civil Engineers' Midlands Association), Alderman D. Johnstone (Lord Mayor of Birmingham), Judge Arthur Forbes and Mr. L. L. Tolley (past-chairman, South Midlands Centre)



responded to the toast of the Association proposed by Mr. W. J. Bird (director, General Electric Co., Ltd.). Alderman W. J. Bennett (chairman of the Eastern Electricity Consultative Council) proposed the toast of "The Electrical Industry" and in the course of his reply Mr. J .O. Knowles (chairman of the B.E.A.M.A. Council) spoke of the opportunities for young men which the industry offered.

The health of the guests was proposed by Mr. J. A. Robertson (vice-chairman), responses being made by the Mayor of Ipswich (Alderman G. W. Pipe) and Col. Henry L. Crouch, Junr. (United States Air Force).

Air Marshal Sir Raymund Hart, K.B.E., C.B., M.C., A.R.C.S., M.I.E.E., who until 31st January was Controller of Engineering and Equipment, Air Ministry, has been appointed Director of the Radio Industry Council in succession to **Vice-Admiral J. W. S. Dorling,** who retired last October. Sir Raymund will take up his duties on 1st March.

Air Marshal Sir Raymund Hart

He was one of the pioneers of radar before the war, and during the war he was responsible for the development of the operational use of radar on the ground and in the air and was chief air signals officer, Allied Expeditionary Air Force, during the planning and operational stages of the invasion of Europe in 1944.

Mr. A. O. R. Johnson, managing director of T. H. & J. Daniels, Ltd., has joined the board of Prat-Daniels (Stroud), Ltd.

The **E.D.A. Silver Jubilee Carnival** was held on 16th January at the Oxford Galleries, Newcastle-on-Tyne, when Mr. T. E. Dellow, chairman, Tyne and Wear Area, Electrical Industries Benevolent Association, and Mrs. Dellow received upwards of 1,000 guests. During the evening 150 prizes, which had been given by all sections of the electrical industry, were distributed to the guests for various events. The proceeds from the carnival will be given to the E.I.B.A.

The **ex-Johnson & Phillips Association** is holding its annual reunion dinner on Saturday, 7th March, at Grosvenor House, Park Lane, London, W.1. Past members of the J. & P. staff who are not members of the Association are invited to write for particulars to Mr. S. W. Foakes, hon. secretary, ex-J. & P. Association, 22, Madison Gardens, Bexleyheath, Kent.

The annual ball of the Birmingham and District Branch of the **Electrical Industries Benevolent Association** will be held on 13th March next in the ballroom of Tube Investments Social Club, Oldbury, commencing at 8 p.m. Tickets (12s 6d each) can be obtained from the hon. secretary, Mr. G. D. Rogers, Electrical Trades Supply, Ltd., Loveday Street, Birmingham, 4 (telephone: Ast. 5671).

In our last issue we reported the appointment of **Mr. R. E. McAlpine** as chairman of the Nuclear Power Plant Co., Ltd., in succession to the late Sir Claude Gibb. We have since received a copy of the portrait of Mr. McAlpine which we now reproduce.

Mr. R. E. McAlpine

A party of 29 Norwegian salesmen of machinery, hardware and electrical appliances returned home on Sunday after a week in this country as the guests of **Black & Decker, Ltd.** In addition to a special sales course at the company's works, the party visited the International Hardware Trade Fair, the Houses of Parliament, and Windsor. They were also received by the Lord Mayor of London. At a reception at the Savoy Hotel Mr. Robert Appleby, managing director of Black & Decker, mentioned that the firms represented by the members of the party sold some £12 million worth of British goods annually. It was believed that much good would come from salesmen abroad having a closer contact with this country.

At the E.D.A. Newcastle Silver Jubilee Carnival. Left to right: Mr. E. Wiggins, Mrs. Wiggins, Mr. R. H. Davison, Mr. T. E. Dellow (chairman, Tyne and Wear Area, E.I.B.A.), Mrs. Dellow, Mr. T. Murphy and Mrs. R. H. Davison

Mr. K. Rigby, A.M.I.E.E., author of the article on "An Angle Measuring Oscilloscope" (page 296), was educated at Manchester Grammar School and received his training in the meter and test department of the Lancashire Electric Power Co., becoming junior engineer and later chief assistant to the workshop superintendent. In 1949 he was appointed testing engineer with the North Western Electricity Board, No. 6 Lakeland Sub-Area, and in 1953 secured his present position as senior assistant engineer (meters, test, protection and communications), Ayrshire Area, South of Scotland Electricity Board.

Mr. K. Rigby

At the annual sales dinner of the Private Telephone Division of **Siemens Edison Swan, Ltd.,** held at the Grosvenor Hotel, London, on 2nd February, Mr. W. G. Patterson, general manager of the Telecommunications Division, awarded the 1958 trophy to the London team for the greatest increase in sales in twelve months. A special award was made to Mr. R. F. Norton (London) for consistently high returns.

The following appointments are announced by L.E.S. Distributors, Ltd.:—**Mr. K. G. S. Croft** to be managing director of L.E.S. Distributors, Ltd., and the L.E.S. group of companies; **Mr. S. W. Byne,** director and secretary of L.E.S. Distributors, Ltd., and financial director to the L.E.S. group of companies; **Mr. L. Heydinger,** director of buying, L.E.S. Central Purchasing, Ltd.; **Mr. O. J. Broughton,** manager, L.E.S. Distributors (Middlesex), Ltd.; **Mr. J. R. Keitch,** assistant manager, L.E.S. Distributors (Middlesex), Ltd.; **Mr. J. C. Knight,** manager, L.E.S. Distributors (Southend), Ltd.; **Mr. A. J. Rowe,** manager, L.E.S. Distributors (Canterbury), Ltd.; **Mr. F. Major,** manager, Wholesale Electric Co., Ltd.; and **Mr. D. Keitch,** assistant manager, Wholesale Electric Co., Ltd.

Mr. J. Sieger has been appointed applications engineering consultant to the Electronic Division of International Engineering Concessionaires, Ltd.

This division is the sole British agent for a range of U.S. specialised electronic equipment. Since 1953 Mr. Sieger has practised as a consultant on both sides of the Atlantic.

Mr. J. M. Reed, of the Metropolitan-Vickers Electrical Co., Ltd., has been appointed hon. secretary of the Manchester Branch of the Electrical Industries Benevolent Association in succession to **Mr. H. Etchells,** who has moved to Preston. **Mr. S. Wilton,** of the South Western Electricity Board, St. Austell, has been appointed hon. treasurer of the Cornwall Branch of the Association.

Mr. P. R. Ewings has been appointed chief purchasing officer of the Siemens Edison Swan group, following the retirement of **Mr. A. Wilton.** He will be at Woolwich works. After training as an engineer with the B.B.C., Mr. Ewings saw war service with the R.A.O.C./R.E.M.E. and was commissioned in the Royal Corps of Signals. Two years of factory and commercial experience were followed by an appointment in the Central Purchasing Department of the British Thomson-Houston Co., Ltd., in 1949, where he became senior buyer. He joined Siemens Edison Swan, Ltd., in 1957 as deputy to Mr. Wilton.

Mr. P. R. Ewings

In this issue we publish an article by **Mr. H. F. Church,** B.Sc., on "Electrical Insulation Faults." After studying physics at University College, London, Mr. Church first took up a research appointment in the photographic industry. He later transferred to the Research Association of British Rubber Manufacturers, then at Croydon, where he worked on hard rubber products. Since 1933 Mr. Church has been employed by the Electrical Research Association where he is now deputy head of the Materials Department.

Mr. H. F. Church

The annual apprentice prize-giving and exhibition of work of **George Kent, Ltd.,** was held on 19th January at the Biscot Road Works, Luton. The meeting was presided over by Commander P. W. Kent, R.N. (chairman), who also presented the prizes. The Bishop of St. Albans was the guest speaker.

Mr. R. H. Hudson, export manager of Dimplex, Ltd., left yesterday (Thursday) on a tour of the company's agents in Scandinavia, Japan, Hong Kong, Australia, New Zealand, South Africa, Rhodesia and Italy.

Mr. G. Barnard, A.M.I.E.E., retired from the National Boiler & General Insurance Co. on completion of pensionable service on 31st January. Originally trained as a colliery engineer and then as a steel works electrical engineer, he was placed in charge of all the Technical Departments in the National Co. in 1951. Mr. Barnard is continuing with professional activities from 23, Park Road, Sale, Ches.

Mr. G. Barnard

Sir John Hacking, the president, was in the chair at last Tuesday's luncheon meeting of the **Electrical Industries Club,** at which the guest speaker was Lt.-Gen. Sir John Glubb, who is perhaps better known as Glubb Pasha, and is probably one of the greatest living authorities on the Middle East and its peoples. He entitled his talk "Britain and the Middle East." A near record attendance (over 230 members and guests) warmly applauded Sir John. A vote of thanks to the speaker was proposed by Mr. E. G. Batt.

Mr. A. R. Cooper, M.Eng., M.I.E.E., M.Inst.F., a full-time member of the Central Electricity Generating Board and director of the Board's Eastern, London and South Eastern Region, is to take up special responsibilities for the operations (including nuclear) and personnel work of the Board. Upon taking up these duties, Mr. Cooper is relinquishing his position as regional director. **Mr. A. E. Hawkins,** B.Sc.(Eng.), A.M.I.E.E., at present system planning engineer, will take up the appointment of chief operations engineer and will be responsible direct to Mr. Cooper for operations including national control. **Mr. S. S. Scott,** M.A.(Oxon), chief personnel officer, will also be responsible direct to Mr. Cooper. In consequence of Mr. Cooper's appointment the following reorganisation will take place on 1st March:—The position of regional director of the Eastern, London and South Eastern Region will be filled by **Mr. H. J. Bennett,** A.M.I.E.E., at present deputy director of the Region and controller of the London Division. **Mr. L. W. Stretton,** M.I.E.E., chief generation engineer of the Eastern Division, will become controller of the London Division. **Mr. P. W. Cash,** B.Sc.(Eng.), A.C.G.I., M.I.E.E., who is at present system operation engineer at headquarters, will take the position of system planning engineer. **Mr. D. P. Sayers,** B.Sc., M.I.Mech.E., M.I.E.E., M.Amer.I.E.E., will remain responsible to the deputy chairman for all commercial matters as hitherto, and will hold the position of chief commercial officer.

The annual dinner of the **Electrical Contractors' Association** took place at Grosvenor House, London, W.1, on Tuesday. A report and pictures will appear in our next issue.

Applications are invited in our advertisement pages today for the position of Director of the **British Lighting Council, Ltd.** The salary offered is £2,500–£3,000.

OBITUARY

Dr. James Albert Darbyshire, chief physicist of a research department at the Ferranti electronics works at Moston, Manchester, was found dead in his laboratory at the factory on 8th February. He was fifty-two.

Nuclear Power Reactor for Japan

Reuter reports from Tokyo that the Japan Atomic Power Co. has stated that it might ask three British nuclear groups to reconsider prices quoted in their tenders for construction of a Calder Hall-type nuclear station. As soon as the basic attitude was decided, the company would probably start new negotiations. A spokesman declined to comment on Japanese Press reports that prices sought by the British were about £4,000,000 sterling more than the £15,000,000 paid by Italy for a similar generator. He pointed out, however, that account must be taken of higher transportation costs and also for making the reactor earthquake resistant. The three British concerns are: the General Electric–Simon-Carves Atomic Energy Group; the A.E.I.-John Thompson Nuclear Energy Co.; and the English Electric-Babcock & Wilcox-Taylor Woodrow Group.

Prices of Materials

In the accompanying table we give the basic prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £180 0s 0d
COPPER, H.C. Electro	ton £231 10s 0d
Fire Refined 99·70%	ton £230 0s 0d
Fire Refined 99·50%	ton £229 0s 0d
COPPER Tubes ..	lb 2s 2¼d
Sheet	ton £260 15s 0d
H.C. wire and strip	ton £283 15s 0d
LEAD, English ..	ton £70 10s 0d
Foreign	ton £69 0s 0d
MERCURY	flask £74 0s 0d
TIN, block (English) ..	ton £773 10s 0d
ZINC, G.O.B. Foreign	ton £73 5s 6d
BRASS Tubes (solid drawn)	lb 1s 9¼d
Wire	lb 2s 7¼d
PHOSPHOR BRONZE Wire	lb 4s 0¼d
PLATINUM	oz £19 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 25¼d—25¾d

TRANSMISSION LINE ACCESSORIES

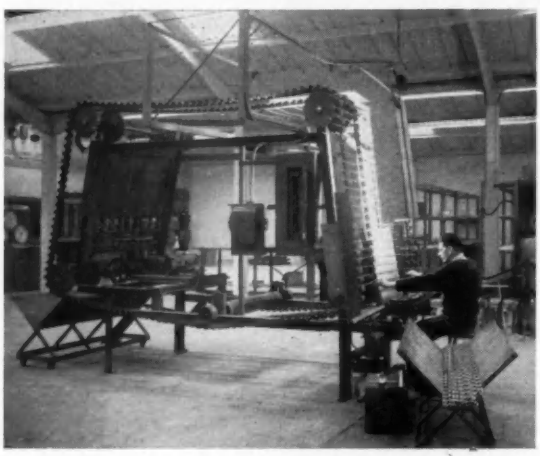
Production Started in New Factory

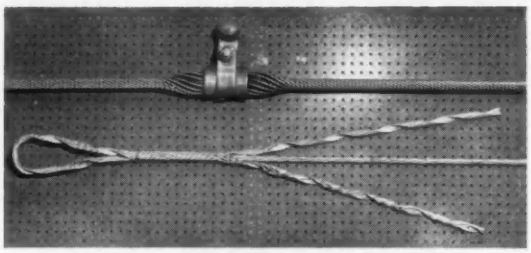
LAST week we paid a visit to the Andover factory of Preformed Line Products (Great Britain), Ltd., to see the range of overhead electrical transmission line accessories now being manufactured under licence from the Preformed Line Products Co. of Cleveland, Ohio. The original production in America of armour rods comprising groups of strands with a pre-formed helix, which were used to prevent conductors being damaged by periodic vibrations set up by wind and ice loading, led to the subsequent development of rods in which the inner diameter of the wire helix is approximately 85 per cent of the conductor diameter, eliminating any tendency to chatter and giving an extremely strong grip. From these a complete range of armouring, splices, shunts, dead ends and guy grips has been produced, now amounting to some 50 designs for all sizes and type of conductors and stays.

Other applications of this principle, now widely used in the United States, include patch rods for repairing minor outer strand damage, restoring full conductivity and mechanical strength to a conductor having up to 25 per cent of the outer strand layer broken, spacer units for 275 kV supergrid conductors, and a suspension unit comprising armour rods, an hour-glass shaped neoprene core, two aluminium supporting castings eliminating the losses associated with iron clamps, and an insulator socket or clevis fitting. Some of the advantages claimed for accessories of this type are the ease and speed of installation, the absence of a requirement for special tools and the use of relatively unskilled labour.

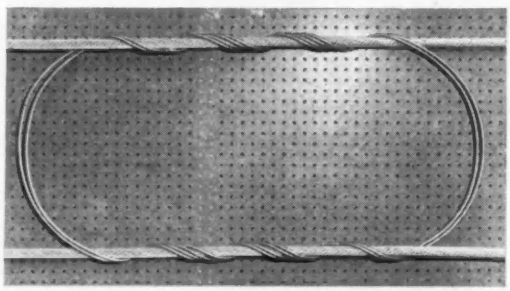
Manufacture in this country began in January in a new single-storey factory having approximately 10,000 sq ft of production floor area with an additional 2,000 sq ft for offices, built and put into operation within seven months. Aluminium alloy, cadmium copper, galvanised or stainless steel wire is taken from a drum, passed by three pairs of feed rolls through a steel die imparting a helical configuration of the desired pitch, and divided into the required lengths by a rotary cutter. Variable-speed motors drive both the feed rolls and cutter, and control of the wire length being cut is obtained by varying the speed of either or both motors. A check of diameter, pitch and length is made of each length, which is then cleaned by a rotary wire brush, any burrs being removed by a sand belt.

Adhesive drying takes place under infra-red lamps





A partially applied guy-grip dead end, with an armour grip suspension



A twin conductor spacer

The strands are grouped by hand into sub-sets, dipped in a de-greasing bath and dried. An air-drying adhesive to retain the strands in their sub-set is applied by rollers, and they are passed on a continuous conveyor under infra-red heaters to assist drying. Paint rollers mark the sub-sets to show cross-over points on dead ends or centre points on splices, a colour code being employed to indicate conductor or guy size. The internal surface of the sub-set is coated in a spray booth with adhesive, and a layer of neutral "Alundum" grit, an aluminium oxide compound, is applied to give a good mechanical grip ensuring electrical contact. A counter is incorporated in the pneumatically-operated bending machine for dead ends.

The factory is equipped with a 20 ton hydraulic tensile testing machine on which cyclic tests can be made, and a tensometer for the routine production testing of the strand wires. Various demonstrations were carried out during our visit in which samples of cadmium copper conductor, galvanised steel wire or high tensile steel bar fitted with the appropriate grips, dead ends or splices were tested to destruction. In each case the specimen fractured at values considerably in excess of its rated breaking stress, whilst the Preformed accessory remained undamaged.

Turbo-Generator Excitation

A SERIES of tests to determine the performance of a normally inactive and a continuously acting turbo-generator automatic regulator were described on 5th February by Messrs. T. H. Mason and F. H. Birch (Central Electricity Generating Board) and Dr. P. D. Aylett (Brunel College of Technology, Acton) before the Supply Section of the Institution of Electrical Engineers. It had been claimed, the authors stated, that improved performance of the recently developed continuously acting regulators at normal lagging power factors would permit safe operation at power factors more leading than those feasible with earlier normally inactive types. This would reduce the generator short-circuit ratio and hence the weight per MW transported, perhaps by 8 to 10 per cent for a 200 MW stator.

With 275 kV transmission a leading power factor, say 0·9, would sometimes be required at exporting stations, when heating at the ends of the stator core of large generators could limit output. Other matters investigated included continuance of the running of a machine on load after loss of excitation and resynchronising after pole slipping.

More than 130 tests were carried out on one of four 60 MW hydrogen-cooled generators at Stella North power station. These sets were connected directly or indirectly through step-up transformers to a 132 kV system based on Stella South power station containing five 60 MW machines and transformers. Both 132 kV systems were connected to the 275 kV system through four 120 MVA transformers. The fault level at Stella North busbars (excluding infeed from the test machine) varied between 2,500 and 3,000 MVA. All nine sets had main and pilot exciters gear driven from the main shafts.

Prior to these tests the safe limit of power factor operation with continuously acting regulators had not been established. Associated leading-reactive-power limiters proved effective in preventing excitation falling below safe values. In Table I steady-state stability limits are compared with those of generators at some other stations. The two different designs of high-response continuously acting regulators maintained steady generator operation with rotor angles in excess of 90 deg and with present designs control could be up to 135 deg in relation to the h.v. busbars. For stator-voltage step changes the initial maximum rate of variation of reactive output was 20 MVAr/sec, which was twice the response of the normally inactive type.

Until recently large generators for connection to the 275 kV system had usually been designed for a lagging power factor of 0·85 and a short-circuit rating of 0·6. The s.c.r. had now been lowered to 0·4 with a maximum leading p.f. of 0·9 and a limitation of rotor angle to 90 deg. The relationship between these factors is shown in Fig. 1.

The rise in temperature at the stator-core ends occurred between 0·8 and 0·7 leading p.f., but was well within permissible limits. This would also be the case with the future larger machines with their higher current ratings, through improved ventilation and hydrogen cooling at 45 lb/sq in.

During asynchronous and out-of-step operation the peak value of power generated by the 60 MW alternator occurred between 0·5 and 1·5 per cent slip. If excitation were lost on full load the machine would continue to run but with a much greater stator current. Quick reduction of load to half rated capacity would bring stator current back to normal at which it could be operated for prolonged periods, apart from the effect of voltage reduction on the system. When using automatic regulators with reactive-power limiters, the possibilities of slipping poles due to excessive reduction of excitation, or of instability due to external faults, assuming normal clearance times, was remote.

Self-synchronising was practicable for generators provided with step-up transformers, the field breaker being

TABLE I.—STABILITY-LIMIT READINGS

Generator	Excitation control	Stator terminal readings						Rotor current Amp.
		kV	Current Amp.	MW	MVAr (leading)	Power factor (leading)	Rotor angle deg.	
60 MW at Stella North s.c.r., 0·59	Hand	11·54	2,180	14	41	0·32	92	105
	N	11·28	2,330	16	42·2	0·35	97	128
	Hand	11·83	2,310	31	34·5	0·67	72	225
	N	—	2,450	31	36·7	0·64	79	220
	C	10·83	4,120	29	69·9	0·38	138	275
	C	10·6	4,800	46·4	74·8	0·53	128	426
	Hand	11·73	3,600	61·4	38·4	0·85	78	420
	N	11·6	4,020	60·2	52·5	0·75	95	420
	C	10·2	5,600	59·6	80·4	0·59	131	580
100 MW, 13·8 kV s.c.r., 0·58	C	11·6	—	108	117–123	0·67	—	650–670
60 MW s.c.r., 0·63	Alternative C	10·25	4,850	49·2	73·6	0·55	129	305
30 MW s.c.r., 0·52	Alternative C	33	750	H.V. busbar readings 28·7	29·7	0·695	105	235

s.c.r. Short-circuit ratio. N. Normally inactive regulator. C. Continuously acting regulator.

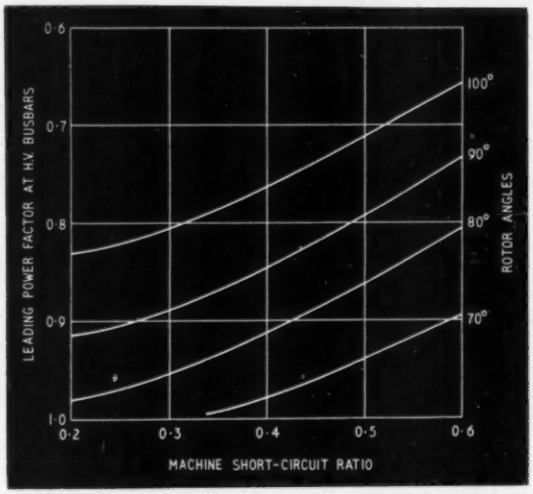


Fig. 1.—Relationship between short-circuit ratio and leading busbar power factor for rotor angles between 70 and 100 deg. Assumptions: (a) Generator rated power factor 0·85 lagging; (b) generator terminal voltage maintained at nominal value by tap changing; (c) generator step-up transformer reactance 17 per cent

closed after the transient inrush of current had fallen away, say 5 sec after the closing of the main circuit-breaker. Possibly, however, the end-winding insulation might suffer some damage after a number of such operations.

Discussion

Opening the discussion Mr. W. D. Horsley (C. A. Parsons & Co.) said that the tests carried out by the authors were in many respects unique and would be of equal value to the manufacturer and to the operating engineer. In early days inherent regulation was the most important characteristic and automatic regulation was realised to be a great advantage, primarily because of reduction in power factor and increase in reactance. With the growth of supply systems instability problems were encountered and the authors had shown clearly the effectiveness of the voltage regulator in maintaining stability at rotor angles well beyond the theoretical limits.

Mr. L. W. James (Central Electricity Generating Board) submitted that in general the results of the tests bore out the expectations of the design engineers. All operating engineers should examine them in detail and if possible witness similar tests in their own power stations. If they were not fully conversant with the action to be taken in the event of abnormal operation of the kind envisaged in the paper, a large part of their value would be lost.

Dr. F. Busemann (E.R.A.) referred in particular to out-of-step operation. He appreciated the difficulties of the authors in correlating the time scales of different records taken with different recording gear and he had tried for his own benefit to rearrange the time scales as shown by slides. On the whole the tests gave very good information and it would be interesting to see how they compared with full-scale work.

Mr. V. J. Vickers (English Electric Co.) expressed interest in the suggestion that control room staffs might be given a direct demonstration of a machine or shown a film. He remembered an occasion when a 40 MW turbo-alternator was left for at least 45 minutes while its control staff telephoned desperately to their neighbours to find out who was causing the disturbance on the system. Rotor angle indicators and field forcing relays would have prevented this happening.

Mr. J. K. H. Thomson (A.E.I.) said that direct water cooling considerably increased the possible loadings of stator windings without exceeding safe insulation temperatures. The two problems which arose when low short-circuit ratio machines were operated at leading power factors—the maintenance of stability and stator core end heating—were the subject of recent tests.

Mr. W. Casson (C.E.G.B.) referred to tests carried out during the past ten years on the grid system on cylindrical rotor-type generators to ascertain more about their performance when operated with reduced excitation from their own exciters and when operating asynchronously. From the results a greater understanding had been obtained of the performance of these machines.

Mr. V. Easton (General Electric Co.) said that in regard to stability, the optimum value of the damping included in the regulator was not constant but depended on operating conditions. A compromise was therefore necessary to get the best conditions for normal operation. The machines tested were relatively old ones and if the results were applied to machines of more modern design they would not necessarily be correct.

Mr. J. G. Miles (Metropolitan-Vickers) considered that the satisfactory agreement obtained in the tests enabled one to design the optimum regulator for any particular application. It allowed one also to predict the effects of regulation in applications other than those considered in the paper.

Mr. K. C. Parton (General Electric Co.) described his experience with a 60 MW machine with a signal-operated regulator depending on rotor angle and showed a number of slides.

Mr. E. B. S. Powell (C.E.G.B.) referring to the effect of a sudden change of system impedance, said tests had shown that the old Tirrill regulator was often very useful in securing steady running. Greater advantage could be taken of those in existence throughout the country.

Mr. J. A. Soper said that the Tirrill regulator mentioned by Mr. Powell was run at 120 deg for a considerable time. In one case the machine swung right over to 150 deg, but the regulator pulled it back in again. The exciter was a plain shunt machine.

Mr. D. R. Fenwick (Metropolitan-Vickers) said the immense value of the tests to designers of regulators could not be over-estimated. Up to now, they had had to go on theory but they now had facts on which to base future developments. The Tirrill regulator had quite good characteristics and was continuously acting, but it was not capable of coping with the extremely high excitation power now required. Future action should be directed towards raising the natural frequency of regulating systems to improve their transient response characteristics, which had largely been neglected up to the present.

Floor Warming Association

MANUFACTURERS of floor heating equipment came into close touch with one another when the subject of purchase tax upon floor warming installations was under discussion. It was then suggested that a small committee should be set up to form an association and Messrs. R. D. Jackson (Tyrad Electric, Ltd.), R. F. Weaire (Panelec (Great Britain), Ltd.) and E. C. Green (Thermodare (Great Britain)) were appointed.

As a result of meetings of this committee it was agreed to establish an Electric Floor Warming Association, open to all manufacturers offering a complete floor warming system and a design service. The objects are to improve the standards of floor warming generally; to represent the interests of members and users; to establish, other than guarantees, liabilities to users; to represent the members in matters involving Government Departments and other bodies; to exchange technical information involving broad principles; and to discuss items of common interest and arrange from time to time relatively interesting talks and discussions.

Membership now includes the following manufacturers:—Aerialite, Ltd., Calidec, Ltd., Panelec (Great Britain), Ltd., Pyrotenax, Ltd., Simplex Electric Co., Ltd., Thermodare (Great Britain), Tyrad Electric, Ltd., and Wandleside Cable Works, Ltd.

The acting chairman is Mr. E. C. Green and for the time being the address of the Association will be 94-98, Petty France, London, S.W.1.

National Society for Clean Air

PROCEEDINGS of the 25th (Llandudno) Conference, 1958, of the National Society for Clean Air (Palace Chambers, Bridge Street, London, S.W.1), pp. 112, 12s 6d net, are now available (see *Electrical Review*, 31st October).

In addition to the sessional papers and discussions on technical and administrative matters it contains an address by the Minister of Housing and Local Government, the Des Voeux Memorial Lecture by Sir William Holford on "Clean Air, Urban Amenity and the Growth of Towns," and a presidential address by Dr. R. Lessing.

Progress at Berkeley

Construction at the Half-Way Mark

TWO years after the commencement by the A.E.I.-John Thompson Nuclear Energy Co., Ltd., of work on the 275 MW nuclear power station at Berkeley, Gloucestershire, the construction is about half-way towards completion and last week we had a look at the site and buildings. At Berkeley there are two gas-cooled graphite-moderated reactors, each with eight heat exchangers, supplying steam to four mixed pressure (310 p.s.i. at 604 deg F and 64 p.s.i. at 596 deg F) turbines which are coupled to 83 MW, 11·8 kV hydrogen-cooled alternators.

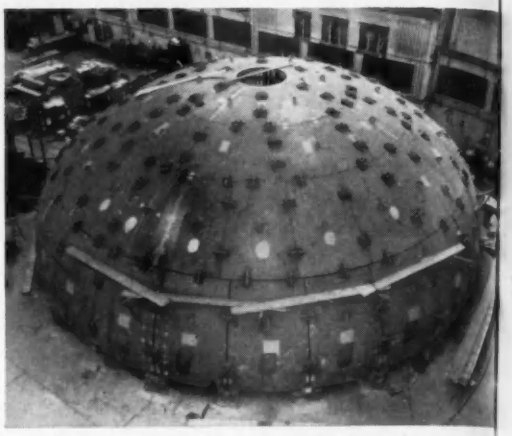
John Laing & Son, Ltd., have completed most of the civil engineering work on the reactors and cooling ponds for which they are responsible. Altogether they have placed 100,000 cu yd of concrete, 5,500 tons of reinforcement and 1,600 tons of structural steelwork.

The John Thompson Group is undertaking the construction of the reactors and associated plant including the heat exchangers. The two pressure vessels are 80ft high and about 50ft in diameter. They are of 3in welded steel plate and each consists of top and bottom bowls with a central cylindrical body. The completed vessel weighs about 1,000 tons and the diagrid at the base, which carries the graphite blocks (about 2,000 tons) within the vessel, weighs 160 tons. To avoid heavy crane loads, each plate is lifted individually into position for welding; in this way the heaviest single load handled is about 13 tons. Each heat exchanger shell consists, like the pressure vessel, of top and bottom domes and central body, in this case of 1⅛in plate. The sections are fabricated at John Thompson's Wolverhampton works and taken to the site where there is a specially-erected boiler assembly shop in which they are put together. The

This aerial plan of the Berkeley nuclear power station gives an idea of the extent of the site. To the left of the centre is No. 1 reactor which is well advanced. No. 2 is a little to the right and the turbine hall is the long building behind them. At the top right-hand corner is a bungalow colony housing many of the "key" men and their families. On the left is the inlet from the Severn for the circulating water. The C.E.G.B. switchgear compound is in the foreground

Left : Close-up of No. 1 reactor with its heat exchangers

Below : Lower dome (inverted) of the first reactor pressure vessel trial-assembled at the John Thompson Wolverhampton works



complete exchangers are moved to their sites and raised to their vertical positions by means of two gin poles and a Lima crane.

We saw that the No. 1 reactor vessel had been welded and work was proceeding on the control rod and charge tube bosses in the top dome. All eight heat exchangers for this reactor are in position.

On the No. 2 reactor the final set of body plates was being sealed in and the plates of the top dome were being fabricated. The diagrid had been placed, and the heat exchanger parts were being welded in the boiler assembly shop. We were told that it was hoped to erect the first exchanger within a month.

In the turbine hall, the structure of which is practically complete, the condenser shells have been installed and tubing is proceeding. Through its Turbine Generator and Heavy Plant Divisions, Associated Electrical Industries, Ltd., is supplying the turbo-generators, two " dump " condensers (for the reception of steam in case of shut-down of the generating plant), steam jet air ejectors, heat exchangers, oil coolers and hydrogen coolers. Other A.E.I. equipment includes sixteen gas circulators and gas duct bellows units. The British Thomson-Houston Co. is supplying the control rod actuators and nearly 1,000 auxiliary motors up to 750 h.p., representing a total of about 22,000 h.p.

Sufficient has now been done at Berkeley to enable an idea of the station's final appearance to be gained. However misplaced opponents of the station may consider it, our impression is that it will form an imposing group.

AGREEMENT WITH EURATOM

DETAILS of the agreement for co-operation in the peaceful uses of atomic energy signed last week by representatives of the United Kingdom Government and of the European Atomic Energy Community (Euratom) are given in a White Paper (Cmnd. 649, H.M. Stationery Office, 9d). It provides for the interchange of " unclassified " research information. Where such information is regarded by the holder as being of commercial value it will be transmitted only at such time and on such commercial terms and conditions as may be agreed in each case.

The United Kingdom Atomic Energy Authority and Euratom will encourage the granting of sub-licences to persons within the Community or the United Kingdom by persons holding licences from the Authority or the Community in respect of patents held by them. Also the two organisations will make available to each other or to persons within the Community, on commercial terms, licences under all patents owned by them relating to the manufacture of fuel or in other agreed cases. The exchange of experts and students is also provided for.

The Authority and the Commission are to assist persons in their areas to obtain research and power reactors and help them to gain assistance in the design, construction and operation of reactors. They will also provide, on commercial terms, assistance in the provision of facilities for the manufacture and processing of fuel.

The Authority undertakes to provide and process fuel for members of the Community and there is a clause which provides that, unless it is otherwise agreed, the form and content of any irradiated fuel elements shall not be altered after their removal from reactors and before delivery to the United Kingdom. There are other articles to ensure that material and equipment shall be used only for peaceful purposes.

The contracting parties are to co-operate in securing suitable measures to provide adequate financial protection against third party liabilities. The agreement is for a term of ten years.

Energy Balance in Feed Systems

A QUICK and accurate method of comparing heat balances in feed systems of steam power plants or estimating the effect of alterations was proposed by Dr. R. S. Silver at the Institution of Mechanical Engineers on 30th January. The basis is the preparation in advance of stock tables of coefficients for given steam conditions (the calculations for which call for no advanced mathematics) to meet the varied conditions likely to arise in practice. The data given primarily applies to marine installations (several examples of which were worked out), but is said to be very much more easily applied in land service.

UNDERGROUND TRAIN FIRE

THE report of Col. D. McMullen, Inspecting Officer of Railways, on the electrical fire which occurred on 28th July, 1958, in a tube train between Shepherds Bush and Holland Park on the Central Line of London Transport Railways was published last week (H.M. Stationery Office, 3s 6d). It states that eastbound train No. 2 from Ealing Broadway to Hainault had travelled about half-way through the tube tunnel between Shepherds Bush and Holland Park when severe arcing started in the power terminal box at the end of the leading car. The power cables to the box and the steel conduits in which they lay were burnt away for about 6ft. The arcing produced an intensely hot torchlike flame which damaged the train air pipe, penetrated the rear bulkhead, and entered the guard's compartment. It heated the air in the car sufficiently to burn and blister much of the paint and fittings and to sear the upholstery.

The conclusions are:—Arcing started at the open end of the rear terminal box of the leading car of the train. The fact that the base of the box lid had become welded to the casing in a partially open position suggested that a thimble or a jumper cable plug or some such object might have become lodged between a terminal and the lid and that, after fretting away the lid insulation, it caused a short circuit from the positive or negative terminal, and then an arc to earth. However, a search revealed that no jumper plug thimble was missing; furthermore the result of the tests indicated that if arcing had begun in this way it would not have maintained itself. It seems therefore that the arc must have started directly between the positive and negative terminals. These are at 2¼in centres and are set well back from the open end of the binocular insulator. The only explanation seems to be that the insulator was cracked across the ½in wide bridge, possibly by a blow from a loose plug, and that rain, which had fallen heavily on the morning of the accident, had found its way into the box on account of the lid not fitting well into the casing. The water must have reached the base of the binocular apertures and seeped into the crack and, probably assisted by metallic brake block dust, enabled current to flow between the terminals, and eventually an arc to form which burnt away the insulator bridge. Tests showed that once an arc had started between the terminals it would maintain itself and penetrate through to the back end of the terminal box.

It is not possible to say when the damage occurred to the binocular insulator. It may have been of long standing and not noticeable when the binocular was examined and the electrical circuits were tested. Tests were carried out five days before the accident and did not disclose any leakage but this is understandable because the tests were made only between each terminal and earth and not between the terminals themselves. Even if the latter test had been made the insulation might not have been found faulty if the terminal box was dry.

I.E.E. Section Renamed

AT a meeting of the Council of the Institution of Electrical Engineers on 5th February it was decided to change the name of the Radio and Telecommunication Section of the Institution to the Electronics and Communications Section.

In recent years the word "electronics" has been broadly used to cover the evolution of new techniques in fields other than communication and, although the basis of this work may well be attributable to those who have hitherto been regarded as engaged in the radio field, the final applications are often developed by other electrical engineers. Moreover, the incorporation of the word "electronics" into the name of the Section is intended to emphasise to the profession that the Institution is manifestly the learned society for those properly qualified electrical engineers who regard themselves as "electronic" engineers.

At present, while students deciding to embark on careers as electrical engineers in the heavy current field automatically look to the Institution, there is in the light current field a number who may inadvertently draw an unreal distinction between an electrical engineer and an "electronics" engineer, and who may not appreciate the breadth of the field which is covered by the Institution, and the advantage to the development of the science conferred by a single forum for the discussion of all its aspects.

The word "radio" no longer appears in the title of the Section, because it is felt that this word, with its modern connotation of certain limited applications, is now insufficiently comprehensive. The continued inclusion within the sphere of the Section of such interests as navigational aid systems and radar is, it is felt, implied in the new title. So far as the omission of the word "telecommunication" is concerned, it is considered that the word "communications" will be interpreted broadly within the context of electrical engineering, and the change makes for a shorter and at the same time a more comprehensive title.

Small Coal in Industry

IN a paper presented before the Institute of Fuel on 11th February, Mr. J. N. Williams (Wm. Cory & Son) indicated how large coals used in various industries could be replaced by small kinds and burned with better efficiency and economy. The size of coals was related to their other characteristics, e.g., free moisture (probably the most important), ash, ash-fusion temperature, caking and boiler fouling. During the last few years large coal production had been falling by about 1 to 1·5 per cent per annum, mainly because of increased mechanisation of mines, while the country's energy requirements were expected to reach 300 million tons in 1965 compared with 250 million tons in 1955.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

13 A Socket Outlets

I WAS more than interested in Mr. Cameron Brown's letter on 13 A socket outlets because my experience is exactly the same as that of himself and his farming acquaintance.

Only pressure of business over the past few months has prevented me from writing to your paper on this subject. There is something radically wrong in my opinion with the complete design of the 13 A outlets and, in fact, in a house of only some 2½ years' construction I have had to replace two outlets due to burnt contacts and completely discard the use of two outlet adaptors. I have even contemplated replacing all the plugs with the standard 15 A type.

I would be more than pleased to hear what steps are being taken to improve this position.

Edinburgh. GEO. MILLETT.

I WAS most interested in Mr. Cameron Brown's letter about 13 A plugs and sockets.

Two years ago my premises were wired for a number of these sockets for domestic use; my experience makes me wish that the 15 A round pin pattern had been used. It is quite correct that these plugs (of well-known manufacture) are not secure; for instance, a vacuum cleaner in use is sure to cause open circuit.

The two-way adaptor when used makes matters worse and should a three-way be tried, it is a nightmare.

"DISGRUNTLED."

INDUSTRIAL NEWS

R.I.C. Reconstituted

The Radio Industry Council has been reconstituted to co-ordinate only the activities of the association representing the manufacturers of radio and television receivers, components and valves. These are the British Radio Equipment Manufacturers' Association, the Radio and Electronic Component Manufacturers' Federation and the British Radio Valve Manufacturers' Association. The manufacturers of capital goods—transmitters, communications equipment, radar and radio navigational aids, and industrial electronic equipment, including computers—have their own organisation, the Electronic Engineering Association, which in future will be independent of the Radio Industry Council, although still having close links with it and its constituent associations. The British Radio Equipment Manufacturers' Association—not the R.I.C.—will in future be responsible for the national and other radio and television exhibitions; the component and valve manufacturers will continue to support the National Radio Exhibition and to share in its organisation. As we report in our Personal and Social section today, Air Marshal Sir Raymund Hart has been appointed director of the R.I.C. in succession to Vice-Admiral J. W. S. Dorling, who retired last October.

Plant for T.V.A.

C. A. Parsons & Co., Ltd., have been awarded a contract by the Tennessee Valley Authority for a 500 MW turbo-generator, to be installed at the Colbert steam plant, near Tuscumbra, Tennessee. The British bid was $12,095,000 (£4·3 million), the nearest American tenders being those of the American General Electric ($17,563,000) and the Westinghouse Electric Corporation ($17,633,000). The Parsons bid is firm while both the American tenders were subject to escalator clauses.

Power Station Contracts

Two contracts valued at over £900,000 have been awarded to the Mitchell Construction Co., Ltd., by the Central Electricity Generating Board. The first is for the preliminary works and site preparation at Thorpe Marsh power station, near Doncaster, Yorks. Work will begin on this contract immediately and is due to be completed during 1960. It involves considerable earth-moving and filling, the construction of temporary roads, surface water drainage, fencing, pressure mains and sewage pump pits. The second project is for the construction of four reinforced concrete hyperbolic cooling towers and ancillary works at Skelton Grange "B" power station, near Leeds, Yorks. Each tower will be over 300ft high and will be required to deal with the circulating water from one 120 MW turbo-alternator. Constructional operations are beginning at once. The consulting engineers for both schemes are Sir Alexander Gibb & Partners.

Electric Clocks

The 1959 range of clocks and watches presented by Smiths Clocks & Watches, Ltd., has been reduced in size, but is nevertheless still considered to be sufficiently wide to provide for every taste. Models with a limited appeal have been withdrawn and by so doing the company have been able to concentrate on production and minimise delivery delays. At an "at-home" at the company's Great Portland Street, London, showrooms last week it was learnt that although Smiths have produced a number of good designs in 30 hr clocks, more and more people are changing over to electric timekeeping. Wall clocks are becoming increasingly fashionable and several new "Sectric" models have been introduced. Among these the company are particularly proud of the "Dubarry," a 5in dial model in a blue moulded finish with raised silver figures, priced at less than 70s. Other finishes are also available.

The "Autoglow," an electric alarm clock with an illuminated dial announced last year, is now available, also a new ringer, or kitchen timer, in a neat moulded case.

Cable for Kariba Scheme

The accompanying picture shows a drum of 330 kV single-core oil-filled cable, made by British Insulated Callender's Cables, Ltd., for the Kariba hydro-electric project, Rhodesia and Nyasaland, being loaded on the M.V. *City of York*. The drum of cable weighs 25 tons and was made at the Erith Works of the company.

A drum of 330 kV oil-filled cable supplied by British Insulated Callender's Cables, Ltd., for the Kariba hydro-electric scheme (Rhodesia) being loaded aboard the "City of York" in the Royal Albert Dock, London

Batteries for Indian Steelworks

Large orders for battery equipment have been received by Nife Batteries, Ltd., Redditch, for the steelworks which is being constructed at Durgapur, in the Damodar Valley, West Bengal. The plant for the steelworks is being supplied by the Indian Steelworks Construction Co., Ltd., a consortium of British manufacturers. The battery equipment ordered, the total cost of which amounts to about £30,000, will be used for switchgear duties and emergency lighting. The equipment has been specially designed for use in the tropics and all the batteries supplied will be for 110 V, which has been adopted as standard throughout the works for tripping and closing supplies.

Conspiracy Charge Fails

At the Old Bailey last week verdicts of "Not guilty" were given in the case in which Frank Hazlewood, electrical engineer, Joseph Walter Woolley, company secretary, John Richard Bovington, managing director, and the Maybridge Construction Co., Ltd., were charged with conspiracy to defraud the London Electricity Board by false pretences.

Summing up the case, the Common Serjeant (Sir Anthony Hawke) said that the issue was whether these men, of the highest character, had entered into a fraudulent scheme which involved the obtaining of £100, or whether they had embarked upon a complicated process to obtain a document which might have become useful if the need arose.

Multi-Language Brochure

A technical brochure has been issued by Avo, Ltd., for distribution at home and overseas exhibitions. It is printed in seven languages—English, French, German, Swedish, Dutch, Italian and Spanish, and in order to achieve the utmost technical accuracy, each translation was prepared in the various countries concerned. A range of Avo's products is listed on the inside covers and the contents of the brochure comprise seven sections each printed in a different language and colour, and keyed for easy reference.

Refrigeration Exhibition

An exhibition of refrigerators and other equipment for the preservation of foodstuffs has been held this week at the industrial development centre of the Merseyside and North Wales Electricity Board. The display

emphasises the growing importance of refrigeration by electrical means and its application to quick freezing and food packaging processes. L. Sterne & Co., Ltd., showed several new models from its range of refrigerators, Birds Eye Foods, Ltd., gave "taste and try" demonstrations in conjunction with the Food and Cookery Centre, Manchester, and MANWEB and Beattie, Edwards & Co. advised on a new scheme under which frozen food cabinets may be rented at moderate rates.

Furnace for Annealing Steel Coils

A six-figure contract has recently been placed with Birlec, Ltd., by the Whitehead Iron & Steel Co., Ltd., Newport, Mon. Birlec is to design and build a heavy duty continuous driven roller hearth furnace for annealing steel strip in coil. The largest coil to be handled will have dimensions of 4ft diameter by 2ft high and weigh approximately 4 tons. The coils will be carried through the furnace on heat resisting alloy pallets.

The furnace comprises essentially a loading table, inlet lock chamber, brick-lined inlet tunnel, heating chamber, brick-lined retarded cooling chamber, water jacketed cooling chamber, outlet lock chamber and unloading table. The furnace heating chamber, rated in total at 1,200 kW, is to be divided into a number of zones, each with automatic temperature control. A maximum output of five tons per hour is envisaged. There is immediate visual indication of each mechanical operation, so that any fault developing can be rapidly detected. To meet the customer's very stringent requirements as to surface finish of the work, controlled atmosphere of special purity will be provided from a generator of novel design.

Crompton Films

Crompton Parkinson, Ltd., have produced three films on their rotating plant, cable and switchgear products. All three films, which will show manufacturing sequences in five of the Crompton Parkinson factories, are in Eastman Colour with commentaries which are not too technical. The titles of the films are "Driving Force," "Mile After Mille" and "Controlling Link," and these, with an earlier film, "Strictly Instrumental," are available to schools, technical colleges and engineering societies, etc., for showing on 16 mm sound equipment. Illustrative material with a prepaid invitation card is obtainable on request to Crompton Parkinson, Ltd.

Brook Motors Ambulance Centre

Brook Motors, Ltd., has recently opened a new ambulance centre at its Huddersfield works. There are eight rooms in the block, comprising a main waiting room, male and female treatment rooms, male and female rest rooms, separate waiting and treatment rooms for senior male staff, and a medical staff office. Among the services available are chiropody treatment—a qualified chiropodist calls twice weekly—ultra-violet ray (artificial sunlight) and infra-red ray treatment.

The auditorium of the new Columbia Theatre, Shaftesbury Avenue, London, which was opened last week. The electrical installation was carried out by Troughton & Young, Ltd. General lighting is by bare lamps recessed into the ceiling

Crushing Plant for Nigeria

Following the successful operation of a Dixie hammermill plant for crushing shale at the Cauldron Cement Works (one of the Blue Circle Group), an order has been placed with the Fraser & Chalmers Engineering Works of the General Electric Co., Ltd., Erith, for the supply of a similar plant with larger units for the new Western Nigerian Cement Works of the Blue Circle Group of Associated Portland Cement Manufacturers, Ltd. The crushing plant will comprise a feed hopper, a variable-speed inclined apron feeder, 72in wide by 21ft 6in long, and a Dixie non-clog hammermill, size No. 6060, with the necessary chutes and discharge hoppers.

The hammermill, of fabricated steel with an all-welded frame, will weigh about 50 tons. The main hammermill drive will consist of a 500 h.p., 700 r.p.m. slip-ring motor directly connected to the rotor shaft through a rubber-tyre type of flexible coupling.

"Engineer" Buyers' Guide

The 1959 edition of *The Engineer* Buyers' Guide, although being confined to advertisers in *The Engineer* or in the Guide itself, nevertheless is a useful up-to-date list of suppliers of a wide variety of engineering products and services. The Buyers' Guide section has 744 pages containing over 33,500 entries under about 2,500 classified headings. There is also a list of forthcoming engineering and industrial exhibitions. One copy of the Guide is given free to regular subscribers of *The Engineer*; additional copies are obtainable at 9s 3d each (including postage) from the manager, *The Engineer*, 28, Essex Street, Strand, London, W.C.2.

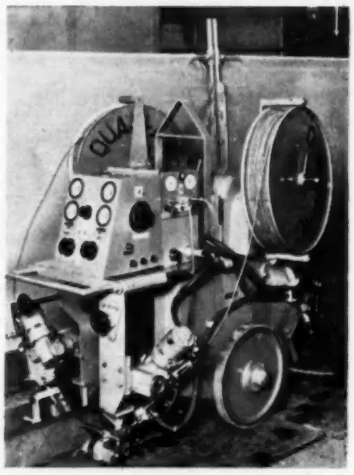
Generating Plant for Angola

A firm in Angola (Portuguese West Africa) wishes to purchase a 500 h.p. gas-oil engine and three-phase generator with the necessary switchboard. Any makers interested can obtain details from this office.

Automatic Welding Machine

A self-propelled twin-fillet welding machine, designed and manufactured at the Gateshead Works of Quasi-Arc, Ltd., is now operating in the Haverton Hill Shipyard of the Furness Shipbuilding Co., Ltd., on Tees-side. The welder consists of a self-propelled carriage on which are mounted two automatic Fusarc/CO_2 welding heads, enabling twin horizontal-vertical fillet

Quasi-Arc twin-fillet welder



welds to be made simultaneously. The machine traverses at speeds between 12 and 36in per minute with a maximum welding speed of 26in per minute, producing approximately 800ft of fillet weld per shift.

Oil Tanker Turbines

W. H. Allen, Sons & Co., Ltd., Bedford, have received a contract for the steam turbine generating plant for a new 32,350-ton oil tanker, the first and largest yet ordered for building in Australia, comprising two 600 kW back-pressure turbo-alternators, designed to operate at a steam pressure of 585 p.s.i.g. and a temperature of 840 deg F, exhausting at 15 p.s.i.g. Each of the turbines, running at a speed of 11,500 r.p.m., will drive, through parallel-shaft speed-reducing gears, an Allen 600 kW, 3-phase, 50 c/s, 415 V alternator running at 1,500 r.p.m. The new tanker is being built by the Broken Hill Pty. Co., Ltd., at Whyalla, Australia, for the Ampol Petroleum Co., Ltd., Sydney.

Automatic Mill Exhibition

A demonstration van showing how a complete rolling mill can be controlled automatically, which is at present on a six-month tour of major steelworks and non-ferrous works in the United Kingdom, is spending a fortnight in the Birmingham and Wolverhampton areas. It has already toured Scotland and the North of England and after the Midlands it will visit South Wales and Southern England, concluding the tour in London. Demonstrations and lectures are being given at universities in the areas visited as well as at works. The van, which has been fitted out by the English Electric Co.'s Metal Industries Division, contains a working model of a rolling mill, on a scale ½in to the foot. The model is controlled by full size automatic equipment.

Industrial Safety Association

Manufacturers of industrial safety (personal) equipment are in process of forming an Association, the objects of which include the improvement of standards in the design and construction of such equipment and the promotion of education in its uses. A meeting is being held on 17th February (2.30 p.m.) at the National Union of Manufacturers, 6, Holborn Viaduct, London, E.C.1, to which all those concerned with the manufacture of industrial safety (personal) equipment are invited. A draft constitution will be submitted which, on adoption, will enable the Association to be formed and commence operations.

Export Licensing Control

The Board of Trade announces certain changes in export licensing control which will substantially reduce the range of goods requiring licences. Effect is given to these changes in the Export of Goods (Control) Order, 1959, which will come into force on 16th February. The changes result from amendments to the list of goods subject to an embargo on export to the Soviet bloc and China and from the further measures announced for the freer convertibility of sterling and certain European currencies. The goods from which export control is removed include virgin aluminium, mercury, mild steel sheets, nickel, silver and silver alloys, ores and concentrates of copper and molybdenum, various electronic and precision instruments and various atomic energy instruments and appliances. Many entries have been redefined, in most cases reducing the scope of the control.

Export control has been imposed for all destinations on a number of goods, including the following:—Lithium compounds, various niobium alloys, nickel wire mesh, climatic conditioning chambers, specified military electronic equipment, high energy military fuels, missile refuelling apparatus, and nuclear reactors; and to countries other than the Commonwealth, the United States and the Republic of Ireland on the following:—Specified communication equipment, certain electronic components and electromagnetic wave absorbing materials.

Electric Locomotives for the Sudan

The Sudan Railways announce the placing of an order valued at approximately £1,500,000 with the English Electric Co., Ltd., for fifteen 1,875 b.h.p. main-line diesel-electric locomotives for general service on the Railways' 3ft 6in gauge tracks, including the haulage of heavy cotton crops from Khartoum and the interior to Port Sudan. The locomotives will have a Co-Co wheel arrangement and will weigh 99 tons in working order. They are designed for a maximum speed of 85 k.p.h. and dynamic braking is incorporated. The design also provides for a full width body with a driving cab at each end so that the locomotives will be generally similar in appearance to the diesel-electrics recently built for Malaya by Robert Stephenson & Hawthorns, Darlington, who are members of the English Electric Group. Power will be supplied by twelve-cylinder CSVT type diesel engines manufactured at the company's Preston Works, where the traction motors and other electrical equipment will be produced. The Vulcan Foundry, Newton-le-Willows, another English Electric member, will be responsible for the construction of the mechanical parts and for the erection of the locomotives.

International Instrument Show

Products from over 50 manufacturers in ten countries will be shown at the 5th International Instrument Show, sponsored by B & K Laboratories, Ltd., which will be held at the International Instrumentation Centre, 4, Tilney Street, Park Lane, from 6th to 10th April. It will be open each day from 10 a.m. to 7 p.m. except on Monday, when the official opening will be at 11.30 a.m., and Wednesday, when it will remain open until 9 p.m. Several new instruments and components will be shown, including high speed analogue and digital instrumentation, developments in e.h.f. power measurement and frequency analysis, new measuring microphones and ultra-precision magnetic tape data recorders.

Applications for tickets should be made to the organisers, either at 4, Tilney Street, or 57, Union Street, S.E.1.

Aluminium Conductor Manufacture in India

On 16th January, the first reel of aluminium conductor manufactured at the new works of Aluminium Industries, Ltd., Kundara, Kerala State—India's largest manufacturers of aluminium conductors and acces-

Group at the Hirakud works of Aluminium Industries, Ltd. Fifth from left is Mr. V. G. G. Nayar, general manager. On his right in the photograph are Mr. M. S. Thirumale Iyengar (chief engineer, Hirakud Dam Project) and Mr. Sailendra Narain Bhanj Deo (Minister for Works, Orissa State). Fourth from left is Mr. B. V. D. Menon, director of the company

sories—was handed over by Shri V. G. G. Nayar, the general manager of the company to Mr. M. S. Thirumale Iyengar, chief engineer, Hirakud Dam Project, at Hirakud in Orissa State. The function was presided over by Mr. Sailendra Narain Bhanji Deo, Minister for Works, Orissa State.

In handing over the reel Mr. Nayar mentioned that the company had manufactured 150,000 miles of conductors.

Earlier, Mr. B. V. D. Menon, director of the company, welcomed the gathering. He said that the chief reason that prompted the company to build the plant at Hirakud was that the Indian Aluminium Co., their principal raw material supplier, who already had an aluminium smelter in Kerala State, was building a new 10,000 ton smelter at Hirakud. Mr. R. K. Nair, project engineer, said that the total floor area of the factory buildings was a little over 50,000 sq ft and that a considerable quantity of aluminium sheets had been used for roofing and side-cladding, and aluminium conductors for electric power and lighting.

The Minister said it was gratifying to note that aluminium metal produced with Hirakud power would be used by Aluminium Industries, Ltd., for making conductors, thereby also helping the country to conserve its slender foreign exchange resources.

To mark the occasion Aluminium Industries, Ltd., produced an illustrated booklet detailing the company's history and operations. The Kundara works, commissioned in 1950, is stated to have an annual production of 9,000 tons of steel-reinforced and all-aluminium conductors. In 1957 a new plant capable of producing 10 million yards of covered aluminium wire was started up.

South African Transformer Contract

Crompton Parkinson, Ltd., have been awarded a contract by the Electricity Supply Commission of South Africa for the supply of two 72 MVA, 132 kV generator transformers for the Umgeni power station, near Durban. The value of the contract is approximately £130,000. The transformers will be used with two 60 MW turbo-alternators, the first of which is due for completion towards the end of 1960. The transformers will be manufactured at the Hayes works.

Electrical Commercial Travellers

The annual luncheon of the Electrical Trades' Commercial Travellers' Association will be held on 20th February (12.45 p.m.) at the Connaught Rooms, London. Members can obtain tickets from the hon. social secretary, Mr. F. J. E. Simons, 42, Lower Barn Road, Purley, Surrey (telephone: Uplands 6078).

The 1959 edition of the Association's handbook contains a message from Mr. S. E. R. Barker, the chairman, and sets out the objects of the Association and the advantages which commercial travellers, who are members, enjoy. It also gives particulars of the arrangements for the year in London, and of the Midlands, North-Western and South Wales Branches, with the names of the officers, and an application form for membership.

Works Visit

At the invitation of the British Radio Corporation, Ltd., His Excellency Ihsan Pasha Hashim, Jordanian Ambassador, visited the Thorn Electrical Industries factory at Enfield where Ferguson, "His Master's Voice" and Marconiphone television receivers are made. His Excellency was accompanied by his daughter, Miss Randa Hashim, and Mr. S. J. Khouri, director of K. S. Boutagy & Sons (London), Ltd. (London office of the H.M.V. distributors in Jordan). The party were shown the press shop, cadmium plating plant and TV assembly lines.

Lamp Price Reductions

Siemens Edison Swan, Ltd., have reduced the price of their "Silvalux" coiled coil lamps from 2s 5d to 1s 11½d for 40 W and 60 W lamps, and from 2s 10½d to 2s 6½d for 100 W lamps. The pink pearl 150 W lamps are reduced from 3s 9d to 3s 4d. All prices include purchase tax.

Youths to Pay Compensation

Two youths, both farm workers, pleaded guilty at Warwick last Friday to maliciously damaging 14 insulators on a 33 kV line by shooting at them with catapults. It was stated that as a result there was a power failure over 200 square miles of South Warwickshire on 4th January and the electricity was not restored to the general public for periods ranging from 1½ to 6½ hours. The youths were placed on probation for 12 months and each was ordered to pay compensation at the rate of £1 a week until the £87 11s 11d damage was paid for.

Trade Announcements

Hoover, Ltd., announces an expansion in the administrative structure of its home sales organisation under the guidance of the general sales manager (home), Mr. R. T. Griffiths, and his deputy, Mr. A. W. Bunn, involving a number of new appointments.

Electrical Safeguards, Ltd., has moved its offices and warehouse to 415, Beulah Hill, Norwood, London, S.E.19 (telephone: Gipsy Hill 7079).

Mr. D. F. Carter is joining the Ferguson Division of **Thorn Electrical Industries, Ltd.,** as sales representative for the West Midlands area on Monday next. He was previously an area manager with Vidor, Ltd.

Following their policy of expansion throughout the Commonwealth and western hemisphere, **Winn & Coales, Ltd.,** London (whose subsidiary, Denso of Canada, was formed last year in Toronto), announce the inauguration of an American company —Denso Incorporated, with offices in Detroit, Mich., and Camden, N.J.

An exhibition was arranged by **Imperial Chemical Industries, Ltd.,** in the cinema of Imperial Chemical House, Millbank, London, on 28th January. Recent developments in the production and use of "Diakon" acrylic moulding materials were on show and demonstrations of dry colouring and injection moulding were made.

Owing to the continued expansion of the Mechanical Handling Division of **Salisbury Precision Engineering, Ltd.,** it has been decided that Sherpa sales shall be run direct from the head office at Castle Road, Salisbury (telephone: 4291). A showroom will be retained at 1, Buckingham Palace Mansions, Buckingham Palace Road, London, S.W.1.

High Duty Alloys, Ltd., has opened a new Midland area sales office at Queen's College Chambers, 38a, Paradise Street, Birmingham, 1 (telephone: Midland 3286). The company announces that all home market inquiries and quotations in regard to forgings will be handled from a new Sales Department of the Forging Division at Windsor Road, Redditch (telephone: Redditch 711). Mr. G. F. Ingram has been appointed sales manager and he will be supported by Mr. F. Clark as sales office manager.

The London offices and showrooms of the **Windsor Group** are now at 76, Jermyn Street, S.W.1 (telephone: Whitehall 0411). The group includes R. H. Windsor, Ltd., Klaxon, Ltd., and Webley & Scott, Ltd.

Allen & Pope, Ltd., have opened new showrooms displaying contemporary and traditional lighting fittings at 32, Shacklewell Lane, London, E.8.

Connollys (Blackley), Ltd. (Winding Wire Division), announces the appointment of Mr. J. L. Stephenson as its sales representative in the southern counties.

Rist's Wires & Cables, Ltd., has produced a display card bearing samples of its range of electrical cables and flexibles, suitable for house wiring and industrial purposes. This is attractively coloured in royal blue and primrose yellow.

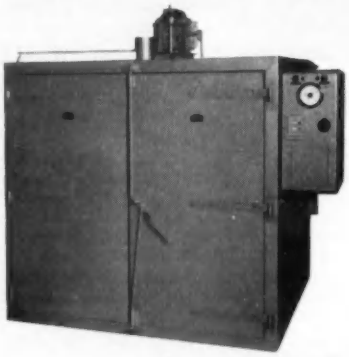
The **Modern Equipment Co., Ltd.,** has purchased a factory at Court Ash, Yeovil, with an area of 12,000 sq ft and it will be moving from Bridgwater to this address at the beginning of March. The premises have large office accommodation and ample manufacturing space to cope with the demand for the company's clothes dryers, convector heaters and electrical appliances. A number of new lines will be in production shortly.

NEW ELECTRICAL EQUIPMENT

Medium Capacity Ovens

A range of medium capacity electric ovens incorporating double skin steel construction and glass fibre insulation has been announced by HEDIN, LTD., Commerce Estate, South Woodford, London, E.18. The welded angle and channel iron framework can be supplied in sections if required, to facilitate transportation and erection. Double-hinged doors with asbestos heat seals are normally fitted, but a counterbalanced vertical lifting door can be provided to conserve floor space.

One or two air circulating fans are mounted on top of the oven, and the control gear is housed in a separate

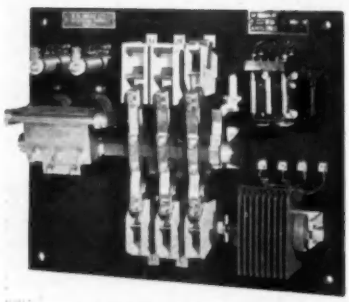


Hedin oven

cabinet. The elements, which have heat resisting sheaths, may be withdrawn for inspection or attention from a position behind the vertical air guides on the oven sides. Ovens are available having internal dimensions ranging from 5ft high by 4ft wide by 4ft deep to 8ft cube.

Emergency Lighting Contactor

A shaft type changeover contactor for emergency lighting systems, having three contacts rated at 30 A 250 V a.c. or d.c., has been introduced by E. N. BRAY, LTD., Control Gear Works, Britannia Road, Waltham Cross, Herts. A voltage relay de-



Bray changeover contactor

energises the operating coil when the normal supply fails, or a 40 per cent voltage drop occurs, and the spring assisted gravity operated contactor connects the load to an alternative supply source. Automatic reclosure, re-connecting the load to the normal supply takes place when this recovers to at least 85 per cent of the normal voltage.

All main contacts have removable arc shields which incorporate splitter plates on a.c. contacts and permanent magnet blowouts on d.c. contacts. The main contactor coil, which is provided with an economy resistance, is d.c. operated, and a metal rectifier is fitted for use when the normal supply is a.c. Coils wound for 25, 50, 100 and 240 V supplies are available. The contactor is normally supplied mounted on an open type ebony "Sindanyo" panel 16¾in wide by 13¾in high but a sheet steel wall mounting box is available if required.

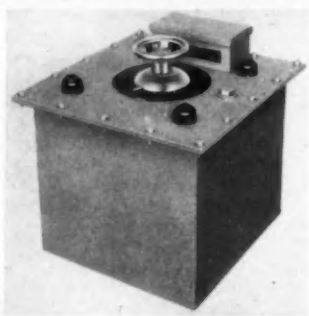
Voltage Regulators

FOSTER TRANSFORMERS, LTD., South Wimbledon, S.W.19, announce a range of toroidal voltage regulators. The "Troidac" range comprises four basic sizes, rated for 2·5, 10, 20 and 40 A. All are designed for a nominal ratio of 240/270 V or 240/240 V. Additional tappings are provided at approximately 25, 50 and 75 per cent of the winding for use with auxiliary transformers.

The smallest unit has the core and the winding, apart from the brush track, encapsulated in polyester resin, protecting the winding against damage in the "back of board" version, and providing a fully insulated and robust portable unit. The 10 A regulator is also a resin cast unit whilst the 20 A equipment is air cooled.

Oil cooling has been employed for the largest unit, rated at 40 A from 0 to 240 V and 35 A from 240 to 270 V. A single unit will provide approximately 9·5 kVA of control and a three-gang version is available. All regulators are wound on cold rolled spiral cores with low flux density to avoid

Foster voltage regulator



undue distortion of the output voltage waveform. They are also available in motor operated form, either as voltage regulators or as voltage stabilisers.

Domestic Refrigerator

The range of absorption type domestic refrigerators manufactured by the Electrical Division of R. & A. MAIN, LTD., 48, Grosvenor Gardens, London, S.W.1, has been extended by the introduction of a new 2·2 cu ft model, the "Main 22." It is 36in high by 21in square and, being of the same height as standard kitchen units, can be easily and neatly incorporated into kitchen unit schemes. The shelf area

"Main 22" 2·2 cu ft refrigerator

is 5·4 sq ft and conveniently positioned compartments in the door accommodate four pints of milk, six eggs, plus small packages, etc.

The ice-making compartment is equipped with two ice trays, each of which provides ten cubes. This compartment is fitted with a plastic lift-off door and, with the ice trays removed, can be used to store up to 2½ lb of frozen foods. The interior liner is a one-piece plastic moulding and the three full-width shelves can be positioned on five sets of runners.

The finish of the refrigerator is in either white or cream, both with embossed red trims on the door. Models are available for the 210-230 and the 230-250 voltage ranges and the maximum input is 90 W. The price, including purchase tax, is £45 3s.

Fluorescent Fittings

COURTNEY, POPE (ELECTRICAL), LTD., Amhurst Park Works, Tottenham, London, N.15, have announced their "Stripline" range of fluorescent fittings. This consists of a standard batten which can be easily converted into a reflector unit or can be used in the form of continuous runs.

The batten is so designed that the end caps and anti-flicker shields are detachable from the tapered metal

channel. To convert the batten into a reflector unit the channel is inverted and a reflector is fixed by means of screws. Alternative end caps are clipped on and the unit is then complete. To form continuous runs, the end caps are removed and replaced by linking connection pieces and double length anti-flicker shields. The batten, in stove enamelled white finish, is available as a one- or two-light 5ft 80 W standard unit.

Spin Dryers

Two spin dryers, manufactured by Rondo of Western Germany, are now being imported into this country by BEST PRODUCTS, LTD., Felix Works, Felixstowe, Suffolk. The smaller of the two is the "Bambino," which will take up to 6½ lb dry weight of clothes at one time and is claimed to be two-thirds the size of the standard spin dryer at present on the market in this country. It has a conical spinner drum with concealed slots at the base. This drum is mounted on the shaft of the motor, eliminating the need for a driving belt. A foot-brake is fitted and an automatic lid-lock operates when the drum is revolving. The dryer is 21in high by 13½in diameter and is priced at £24 19s 5d plus £5 9s 7d purchase tax.

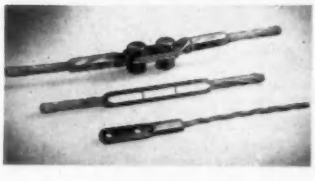
The larger model, the "Felix," is similarly constructed and has a capacity of 8¾ lb dry weight of clothes. It is 24in high by 16½in diameter and the price is £29 5s 7d plus £6 8s 5d.

Best Products "Bambino" (left) and "Felix" spin dryers

Compression Terminals

A range of copper compression terminals for hard drawn copper conductors is now being marketed by the BOWTHORPE ELECTRIC CO., LTD., Crawley, Sussex. Five types of hydraulic tools for use with these conductors are also available, ranging from the 17 ton "Minor" compressor —weight 27¼ lb complete—to the automatic petrol driven "Autopressor."

Bowthorpe compression terminals



Fly and Moth Killer

A new electrical domestic appliance that is claimed to rid the home of flies, moths and other insects has been produced by the TACK ORGANISATION, Longmore Street, London, S.W.1. Known as the "Saxane Junior," it consists of a moulded black polished plastic container measuring 6¼in high by 3½in in diameter. It operates from any electric point (200/250 V a.c. or d.c.) and consumes only 10 W while vaporising one of the special tablets placed in the top of the apparatus.

After a few hours' use in a room, a microscopic film, highly toxic to insects but harmless to humans and animals, is deposited on all surfaces. This remains effective for two or three weeks at a time. The price, complete with a carton of tablets, is £3 3s, replacement tablets costing 5s per carton.

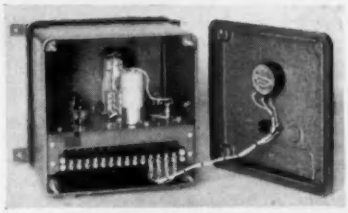
Tack "Saxane Junior" fly and moth killer

Process Timer

A series of electronic process timers has recently been added to the range of such equipment produced by LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, LTD., Rugeley, Staffs. The Series PCT.1 units are available in six basic forms which can be connected together to provide a multi-stage timing control for complete processes.

The six models provide time ranges of 0·1 to 1·5 seconds, 0·3 to 5 seconds, 1 to 15 seconds, 3 to 50 seconds, 10 to 150 seconds and 30 to 500 seconds. Each main time range is sub-divided into ranges selected by a switch, and a continuously variable control is provided for accurately setting the required time interval. The units have a repeat accuracy of ±1 per cent on a stable supply and variations in supply voltage of −15 to +10 per cent do not cause more than ±5 per cent change in the set time interval.

The timers are housed in a cast light alloy case designed for wall- or base-mounting. Suitable sealing arrangements are provided on the detachable covers to prevent the ingress of dust and moisture. The timing controls are mounted on the front of the case, the time setting control being provided with a scale calibrated directly in seconds. All the timers, which are designed to operate from a 200/250 V or 110/115 V, 50/60 c/s single-phase supply, are priced at £11 14s and are available ex-stock.



Lancashire Dynamo process timer

Pipe Manipulator

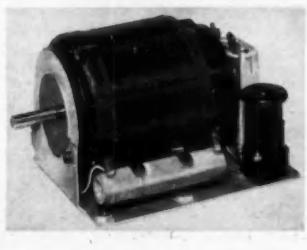
A manipulator for handling pipes being welded in pairs to reduce the amount of manual welding necessary on site has been introduced by QUASI-ARC, LTD., Bilston, Staffordshire. Two pipes up to 40ft in length can be accommodated and rotated during welding to ensure correct alignment. The speed of rotation may be varied, enabling the correct welding speed to be obtained for each size and type of pipe. An engine-driven equipment is available for use on site, generating an a.c. supply for the power operated rollers and a d.c. supply for welding.

Synchronous Motor

A heteropolar synchronous motor has been developed to give a low speed drive without the use of gearing by the NELSON ENGINEERING CO., LTD., Netherfield Road, Nelson, Lancashire. The self-starting motor attains synchronous speed—75 r.p.m. when operating from a 60 c/s supply or 62·5 r.p.m. with a 50 c/s supply—within ½ cycle, and a permanent magnet rotor ensures immediate stopping when the supply is disconnected.

The standard motors, which have a torque of 30-200 ounce-inches, are supplied suitable for connection to 200-240 V supplies, and models for connection to 110 V or other supplies are available. Normally arranged for flange mounting with the capacitor and resistor supplied as separate units, the

Nelson synchronous motor



motors can also be provided on a base plate with capacitor, resistor, and plug and socket incorporated in one unit.

Welding Ammeter

An ammeter for the measuring of welding current pulses of a few milliseconds duration has been introduced by HIRST ELECTRONIC, LTD., Gatwick Road, Crawley, Sussex. The instrument, which has six scales covering a range of 500-100,000 A, may be used

Hirst welding ammeter

with welding machines employing synchronous, non-synchronous and energy storage controls. Where phase-shift heat control is incorporated a correction factor must be used to obtain accurate quantitative evaluation of r.m.s. current, but comparative readings may be taken directly. A standard split and hinged current transformer is normally supplied which will clamp over any part of the welding secondary circuit up to 4½in diameter. Fixed ring type transformers can also be supplied for building into individual welding machines.

Convector Heaters

The Ekco "Thermovent" WM series wall-mounting steel-cased convector heaters just announced by E. K. COLE, LTD., 5, Vigo Street, London, W.1, replace the company's previous MRL series heaters which have been marketed for several years. The WM models are completely restyled, have a smaller projection from the wall, and are claimed to be easier to install.

Two basic sizes are offered, both with a projection from the wall of only 5½in. The smaller one measures 17½in wide by 22½in high and has a standard loading of 1 kW. This model is available with or without automatic heat control and alternative loadings of 750 W or 1,250 W will be available to order. The larger unit measures 26½in wide by 22½in high with a standard loading of 2½ kW. For this model there is a choice of automatic heat control or half-heat switch and an alternative loading of 1½ kW can be provided to order.

All the heaters are finished in hammer-bronze enamel and close-spaced wire guards are concealed behind the inlet and outlet grilles. A 40 W amber-coloured lamp provides a warm luminous effect and the case is detached by releasing two concealed screws to facilitate installation and wiring.

The 1 kW models are priced at £8 15s plus £1 17s 11d purchase tax in the United Kingdom (WM1); and £9 17s 6d plus £2 2s 10d, automatic

Ekco "Thermovent" type WMC25 convector heater

(WMC1). The 2½ kW heaters cost £10 10s plus £2 5s 6d, half-heat switch (WM25); and £11 8s 6d plus £2 9s 6d, automatic (WMC25).

Catalogues and Lists

ACCESSORIES.—28-page loose-leaf catalogue giving particulars of the company's range of moulded connectors, plugs and sockets, aircraft type switches, navigation and other aircraft type lamp fittings and other products of the company.—**M.B. Metals, Ltd.,** Vale Works, Vale Road, Portslade, Sussex.

COIL WINDING EQUIPMENT.—Brochure giving particulars of a range of flyers for use in connection with coil winding machines.—**Shawndel Flyers, Ltd.,** 24, Seymour Place, London, W.1.

DOMESTIC APPLIANCES.—Catalogue illustrated in colour, complete with separate price list, giving particulars of the company's range of coffee percolators and kettles, and details of their electric blanket and electric mattress overlay.—**Best Products, Ltd.,** Felixstowe, Suffolk.

DUST CONTROL.—Brochure illustrating typical dust control units fitted to machinery used in a variety of industries.—**Dallow Lambert & Co., Ltd.,** Thurmaston, Leicester.

FLOOR MAINTENANCE EQUIPMENT.—Broadsheet and brochure dealing with the B.V.C. range of floor maintenance machines, including battery operated and mains powered models for wet scrubbing, scarifying, water pick-up and polishing.—**British Vacuum Cleaner & Engineering Co., Ltd.,** Goblin Works, Leatherhead, Surrey.

FUSES.—Set of catalogue sheets giving details of the range of instrument type fuses, fuseholders, pilot lampholders and other accessories, produced by H. Schurter A.G., Switzerland. The accessories, which include a fuseholder giving visual indication of a blown fuse, are available from the sole U.K. agents.—**Dekko Cameras, Ltd.,** Telford Way, East Acton, London, W.3.

INSTRUMENTS.—Two leaflets dealing respectively with an automatic sulphur dioxide recorder and a polarographic electrode.—**Mervyn Instruments,** St. John's, Woking, Surrey.

LIGHTING.—Design bulletin (No. 4) dealing with simple pelmets and baffles.—**Philips Electrical, Ltd.,** Century House, Shaftesbury Avenue, London, W.C.2.

METAL FINISHING.—Descriptive booklet dealing with the "Bonderizing" range of processes for the treatment of iron, steel, aluminium, zinc and cadmium surfaces, which have a variety of applications in the electrical manufacturing industry.—**Pyrene Co., Ltd.,** Great West Road, Brentford, Middlesex.

MOTOR CONTROL GEAR.—Catalogue illustrating typical control gear and control panels produced by the company during recent years, together with views and details of their Control Gear Division.—**G.W.B. Furnaces, Ltd.,** P.O. Box 4, Dibdale Works, Dudley, Worcs.

PRECISION COMPARATORS.—Details of an electro-mechanical comparator which enables simultaneous gauging of up to 20 dimensions to be made, and providing the operator with a reading of the error above the tolerance on each dimension, are given in a pamphlet received from **Rubert & Co., Ltd.,** Councillor Lane, Cheadle, Cheshire.

SWITCHGEAR.—72-page illustrated and priced catalogue (158/159) covering the company's range of switch and fusegear, socket outlets, and other accessories.—**Wm. Sanders & Co. (Wednesbury), Ltd.,** Falcon Electrical Works, Wednesbury, Staffs.

TELEPHONE AID.—Leaflet illustrating and describing the "Telepoise" telephone receiver holder which gives the user the free use of both hands.—**I. Flatter,** 78, George Street, Portman Square, London, W.1.

THERMOCOUPLES. — Leaflets dealing with multi-junction thermocouples, thermopiles and heaters, and a capacitor type discharge welding apparatus developed primarily for the manufacture of fine wire thermocouples.—**Spembly, Ltd.,** New Road Avenue, Chatham.

WIRES.—Brochure detailing the range of fine wires in copper or resistance alloys which the company manufactures.—**Industrial Processes, Ltd.,** Lomeshaye Mill, Nelson, Lancs.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 21st February:—

Union Carbide (design). No. 773,879. Class 9. Electric dry cells and electric dry cell batteries.—Union Carbide Corporation, New York, U.S.A. Address for service, c/o Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.2.

Decca Flightmaster. No. 774,710. Class 9. Nautical, surveying, navigating, optical, radio, radar, television, signalling, teaching and measuring apparatus and instruments; and scientific, electric and electronic apparatus and instruments.—Decca Record Co., Ltd., 9, Albert Embankment, London, S.E.11.

Mem-O-Matic. No. 777,189. Class 9. Electric dictating machines; record players; radio and television receiving instruments, etc.—V-M Corporation, Benton Harbor, Mich., U.S.A. Address for service, c/o Frank B. Dehn & Co., Kingsway House, 103, Kingsway, London, W.C.2.

Centradict. No. 781,973. Class 9. Electrical apparatus for connecting dictating machines to internal telephonic communication apparatus, etc.—Recorderpool, Ltd., Endurance Works, Maypole Fields, Cradley, Staffs.

Hammond. No. B757,958. Class 15. Electrical and electronic musical instruments.—Hammond Organ Co., Chicago, Ill., U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

PARLIAMENTARY REPORT

IN the House of Lords some opposition was expressed against the proposal to close down the Oystermouth and Mumbles railways at Swansea, which on the Oystermouth section is believed to be the oldest railway in the world. Lord Merrivale, speaking on the South Wales Transport Bill, which seeks authority for the closure, said, "Every year these Private Bills come before your lordships with a view to obtaining powers to do away with electric traction. It is a most regrettable trend and I feel that the evil-smelling transport which will replace it does not in many cases give the public complete satisfaction. . . . Moreover, I do not think that this trend is in agreement with the policy of the British Transport Commission, which is to increase the electrification of our railways. In this case it is a light railway."

Lord Alexander of Hillsborough, Leader of the Opposition Peers, said he had not noticed transport arrangements being improved by changes from electric trolley-buses to diesel buses. Other peers opposed the closure because of the railway's historic importance.

Debate on the second reading of the Bill was adjourned until 17th February.

Increased Trade with China

Lord Dundee, Minister without Portfolio, stated that the noteworthy increases in our exports to China had been in a wide variety of goods and there was little evidence that much of the increase had resulted from the recent relaxations in embargoes, except in the case of copper.

Lord Elibank said that one of the results had been an order for David Brown's for £500,000 worth of turbine gearing.

Fuel and Power Policy

In a debate on fuel and power policy, Sir Ian Horobin, Parliamentary Secretary, Ministry of Power, told the Commons last week that discussions were going on between the oil companies, the Central Electricity Generating Board and the National Coal Board to see if it was possible, within the framework of existing contracts, to postpone the conversion from coal to oil of two more power stations in 1959, as a gesture by the oil companies to the coal industry in its present difficulties. If that was found practicable, the Generating Board would require about one million tons of coal more than was planned under the conversion programme.

On the issue whether the Government should embark on a policy of deliberately switching the economic demands for fuel for the benefit of one of the competing providers of power, the answer, said Sir Ian Horobin, was "a quite definite and firm 'No'." The consumer should have the choice. It would be to the national advantage to have as cheap fuel as possible. Anything that could be done to reduce the price of coal or oil was a good thing, but the Government did not think that anything short of competition would be likely to achieve that. The Government were certainly not proposing to put up the price of oil by putting a tax on it and hoping that in some mysterious way this would reduce the price of coal.

Mr. W. Blyton, who opened the debate, had asked that at least four of the power stations now in the process of being changed over to oil should be put back to coal. The four stations already converted were burning oil of a coal equivalent of 2,380,000 tons a year, he said. It had been stated that the consumption at stations converted to oil would be the equivalent of 8 million tons in 1965.

Mr. Alfred Robens, winding up for the Opposition, said his Party did not object to competition between the fuel industries, but they objected to unfair competition, as there was now between coal and oil. There was no one in the Government who had ever said that the conversion from coal to oil in the power stations was dictated by competition or commercial motives; it was dictated by the shortage of coal at the time. Unless a power station was on an estuary where oil could be unloaded easily, it was doubtful whether oil for any power station in the country would have the edge on coal on a purely price basis.

After Sir Ian Horobin had replied to the debate the House carried a motion endorsing the Government's policy without a division.

Street Lighting Survey

Mr. Nugent informed Mr. Page that the Ministry of Transport was undertaking a national survey of street lighting. He had no exact information yet about how many authorities followed the code of standard lighting.

Victoria Tube

Mr. E. Fletcher asked the Minister of Transport whether he would expedite the plans for the construction of the proposed new Victoria tube to serve North London.

Mr. Watkinson said this project raised difficult financial problems, and it had not been possible so far to find room for it within the British Transport Commission's total capital expenditure. He recognised, however, that it would make a valuable contribution to London travel, and intended to keep it under review with the Commission.

Mr. Fletcher said this was a disappointing answer. Transport delays were increasing all the time. The only solution was the construction of this new tube.

Mr. Watkinson: "Perhaps you are unaware that it would cost £55 million and lose £3 million a year."

Mr. Ernest Davies said the cost of building would be recouped in a few years in the form of savings achieved by avoiding delays.

Mr. Watkinson said he was taking the advice of the London Travel Committee on whether the £55 million might pay a better dividend if it were spent on off-street parking or some other project.

Mr. Redhead said the tube should have priority consideration; the B.T.C. obtained powers to build it in 1955.

Scottish Railway Electrification

Asked by Mr. Hughes to see that the railway electrification needed to attract industry to the north of Scotland was undertaken, the Minister of Transport said he had no doubt that schemes for electrification would be pressed forward.

Mr. Arthur Woodburn, former Scottish Secretary, asked if the portable electrical battery train had been a success in its trial running.

Mr. Watkinson: "I understand it has brought a lot of passengers back to the railway but it is too early to say whether it will make it profitable."

Atomic Submarine

Mr. Chetwynd asked the Parliamentary Secretary to the Admiralty what stage had been reached in the development of the atomic submarine, H.M.S. *Dreadnought*.

Mr. Orr-Ewing replied that the design and assembly of materials were proceeding satisfactorily. It was hoped that the contract with the American company to supply the machinery would be signed soon.

Transmission Costs

Sir Alfred Bossom asked the Paymaster General what was the difference in cost between putting transmission lines underground or carrying them on pylons.

Sir Ian Horobin gave the following figures per mile:—Standard 275 kV supergrid line: Overhead, £25,000; underground, £300,000 - £400,000. Standard 132 kV grid line: Overhead, £10,000; underground, £50,000-£80,000. He said that costs varied according to the sizes of conductors and types of construction used. Underground cable laying costs were particularly affected by different local conditions. In the case of the supergrid, where the cost shown was an estimate, "undergrounding" would also present technical difficulties.

SERVICE CONNECTIONS

Survey of Present Practice and Future Possibilities

By E. H. JESTY, A.M.I.E.E.*

Although service connections may be only a minor item between the generators and the load they are nevertheless most important, particularly as they are installed on private property. Statutory Regulations applying to service connections are discussed as well as the relevant I.E.E. Regulations

THE primary aim of the electricity supply industry is to give the best service at reasonable cost to the consumer, and to the consumer the service connection is the most important part of the huge enterprise. It is important to the industry, too, for the service connection, and the engineering inspection associated with it, can do much to influence consumer opinion and goodwill upon which the industry depends for its effectiveness and, ultimately, for its existence.

The increase in the number of consumers over the past 20 years has averaged nearly a quarter of a million annually and the new generating plant commissioned, notwithstanding a considerable reduction in the rate during the war years, was an average of 850 MW. This represents the addition, every year for 20 years, of load equivalent to that of a very large provincial undertaking of pre-vesting days.

The neglect from which service connections have suffered in the past may be realised from one or two examples, the like of which are not likely, I hope, to be repeated.

(i) Electricity and gas services have been run, deliberately, in the same pipe or in the closest proximity beneath floor boards.

(ii) Intake positions in vaults beneath footways have, in the course of years, been entirely bricked up, and, on failure of an undertaking's service fuse, vaults have had to be broken into through the footway to renew the fuse. As a result of the structural alterations, this fuse was then in premises next door to those receiving the supply through it.

(iii) Some of the pioneer "House-to-House" companies supplying at high voltage with small local transformers thought it adequate to put the transformer in an iron cupboard attached to a wall in a narrow passage, or buried it beneath the floor boards which had to be taken up to insert even a test fuse on to what may have been a faulty transformer.

(iv) Where undertakings had overlapping supply powers (and there were several in London) it sometimes resulted in two services being crammed into an intake position barely adequate for one. This was usually because a consumer on a d.c. system took an a.c. supply from a competing undertaking to supply gaseous discharge signs. Sometimes, it was due to price cutting between undertakings, and it was not unusual for different consumers in one building to be supplied by two different undertakings.

* London Electricity Board.

Transformer chamber at No. 6, Strand, London. Connected on 26th October, 1890, and used until 7th July, 1921. The glazed earthenware container in the centre contains a fuse incorporating a CO_2 capsule arranged to release the gas when heated by the fuse blowing. The original fuse is on the wall. The square box with the glass front houses the 2,500 V air-break main switch

Statutory Regulations

Public supply is afforded subject to the Electricity Supply Regulations, 1937, of which some have a direct bearing on service connections. Many engineers feel that their revision is overdue and it has, in fact, been under consideration for some time. Many are honoured in strict observance, and some are interpreted in different ways.

Regulation 1 (b) refers to the testing for insulation resistance of electric lines "after they have been placed in position and before they are connected to the system." There is no exception in the regulation for service lines, except that it does not apply to overhead lines unless so prescribed by authority in any particular case. It seems curious that overhead services should be exempted from pre-commissioning testing and that underground services should not.

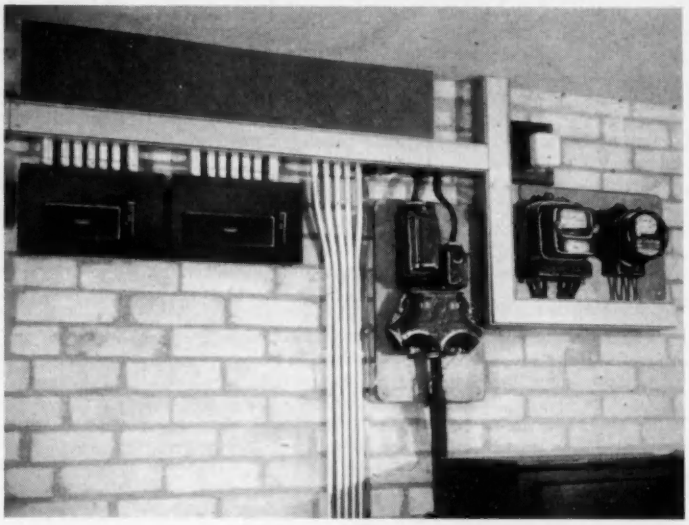
Regulation 6 (b) requires that high-voltage services shall be tested, after laying, to a standard in accordance with the tests specified in the appropriate British Standard for that cable or at 1·25 times working voltage, or at

working voltage plus 10 kV, or, if neither test is reasonably practicable, by 1,000 V for not less than one minute between conductors and also to earth.

It is much simpler, and certainly adequate, particularly where overhead lines are concerned, to energise the cable at working voltage, on soak for a while before bringing it into service for the supply of energy.

Regulation 14 (a) is one which is sometimes overlooked. It provides that precautions shall be taken to prevent any pipe containing a cable from becoming "alive."

Where metal-sheathed cables are used, this is automatically taken care of to some extent by the bonded metal sheathing which is in contact with the pipe. Instances have occurred, however, where metal-sheathed cables have been withdrawn and v.r.i. non-metal-sheathed cables run to give a temporary builder's supply. In one instance, the builder earthed his installation to the service pipe and a fault which occurred on the installation caused the pipe to become "alive" and dangerous.



A modern service connection

Regulation 22 requires that underground services shall enter premises in such a manner as to prevent the influx of gas at the point of entry.

Armoured services are usually built into walls through which they pass, but at times, especially on new constructions, builders leave pipes or ducts through which services are subsequently drawn to save cutting of new walls. Under the regulation it is imperative that they be sealed at the point of entry.

Fortunately, the regulation uses the words "as far as is reasonably possible" since it is often difficult to do the sealing adequately.

Regulation 24 stipulates the provision, by the Boards, of a suitable fusible cut-out or circuit-breaker in every service line as close as practicable to the supply terminals.

This gives rise to some difference in interpretation where multi-consumer property is affected. Some engineers contend that the "supply terminals" are at the termination of the service cable where it enters the building, whilst others maintain that they are in the premises of the individual consumers and that the practice of grouping consumers' fuses in floor distribution boards is not strictly in accordance with Regulation 24.

Regulation 25 makes the Boards responsible for lines and apparatus placed by them on consumers' premises, and either belonging to them or under their control, being maintained in a safe condition.

Opinions differ on the point whether unmetered circuits, under the Boards' seal, but not placed by them, are subject to the provisions of this Regulation.

Regulation 26 specifies a standard of insulation of the consumer's installation in terms which are definite and unambiguous.

In practice, however, it has become customary to call for insulation resistance at least up to the standard set by the I.E.E. Regulations, which is higher than the statutory standard. An installation which a Board chooses to reject on the grounds of poor insulation is likely to have other defects quite serious enough to warrant rejection under Regulations 27 to 29.

Regulations 27 to 29 are "permissive" regulations which empower Boards to take action in certain circumstances (but give them no mandate to do so) and protect them against action by parties who may feel aggrieved in consequence.

The use of the words "reasonably satisfied" allows of widely differing views of the extent to which Boards should inspect, test and carry the responsibility for consumers' installations.

Consumers' Installations

Consideration of service connections cannot be entirely divorced from the Boards' concern with consumers' installations. A limited degree of inspection and testing must be done before the Boards can be reasonably satisfied that the Electricity Supply Regulations are observed, and that giving the supply is not going to interfere with the supply to other consumers or constitute a danger to the public. The statutory regulations are quite clear on this point. Their title is "Regulations for ensuring the safety of the public and for ensuring a proper and sufficient supply of electrical energy."

The question of consumer relationships cannot be ignored, but the adequacy and safety of his installation, as far as he is, himself, concerned, appears to be the responsibility of the consumer and not of the Board. Recent legal judgments endorse this view (e.g. Sellars *v.* Best, York Assizes, 17th February, 1954).

Boards have to decide if, and to what extent, they are prepared to go beyond the minimum tests and inspections necessary to satisfy themselves reasonably in respect of compliance with the Regulations.

Those people who talk excessively of moral obligations of public bodies towards their consumers never suggest that it is reasonable to expect the Coal Board to assume responsibility for the installations which are to consume the fuel which they supply, or that the Gas Boards should assume legal responsibility for their consumers' installations and apparatus.

Contractors' Certificates

The existence and operations of a National Inspection Council may help to ease the already heavy cost of connecting consumers to the mains and yet enable Boards to be "reasonably satisfied" in respect of their compliance with the Regulations.

Installations have to be tested by the person putting

them in and it may be that the enrolment of the contractor by the Council will justify the Boards' acceptance from the consumer of an assurance that the contractor has certified, as provided for on Form A of the I.E.E. Regulations, 13th Edition, the soundness of the installation. In that event, further testing would be superfluous, or could be severely limited and much expense would be avoided.

Boards would not be relieved of any statutory obligations and may yet feel themselves obliged to make tests of installation resistance and a cursory inspection of new installations or additions as a token of their anxiety to connect only installations which are safe and sound.

I.E.E. Regulations

The I.E.E. Regulations have no statutory significance, except that the Minister of Power allows in many respects that compliance with the I.E.E. Regulations shall be deemed to be compliance with the Statutory Regulations.

It is very much to the credit of the I.E.E. that they produced the first edition of their Regulations—or Wiring Rules, as they were called—in 1882, the year of the first Act of Parliament relating to electricity supply. Section 6 of this Act gave power to the Board of Trade to make Regulations, but their first edition did not appear until 1896, fourteen years after the passing of the Act.

I.E.E. Regulation No. 105, 13th Edition, provides that consumers' main fuses need not be provided if the supply undertaking agrees to their omission and sub-circuit fuses or circuit-breakers are within reach from the main switch. All Boards in England, Wales and Scotland have signified their readiness to consider sympathetically applications for the omission of consumers' main fuses. Consumers' control units, to B.S. 1454, make no provision for a consumer's main fuse.

Firemen's Lifts

This is an aspect of service connections which is becoming of increasing importance in the tall industrial and commercial buildings now being erected in war damage reconstruction schemes. Fire brigades like to have the facility of switching off at the main, but leaving supply on to at least one lift, to save time in getting hoses to upper floors.

Architects are inclined to press for a separate service cable for this purpose, but it is properly a matter of design of the consumer's installation and it is uneconomical and wasteful of capital to provide a separate service for this purpose.

Earthing

This particular aspect of service connections provides, and always has provided, material for lengthy discussion which has not been reduced by the appearance in the 13th Edition of the I.E.E. Regulations of Regulation No. 507 which is concerned with the impedance of the earth-path loop. The virtues of the test proposed are by no means universally accepted and little of value can be said in this context except to reiterate that the proper earthing of the consumers' installations is the responsibility of the consumers. This is not to say that Boards are not interested, or that they are not ready, willing and able in very many instances, to assist the consumer in attaining the desirable objective of an earth impedance of a sufficiently low and constant value to ensure the operation of protective equipment upon the occurrence of an earth fault likely to give rise to dangerous conditions.

Future Possibilities

It was reported in the technical Press recently that one Board is experimenting with services of m.i.m.s. cable. This simplifies the termination and completely obviates the nuisance of compound leakage from sealing chambers which occasions annoyance and expense. Similarly, insulations having characteristics of p.v.c. or polythene may be developed to be technically and economically competitive with impregnated paper plus a compound seal at service connections.

Meter Positions

In a very large number of installations in this country little common sense has been exercised when determining meter positions. Prepayment meters are found mounted in positions where aged persons have to mount chairs, etc., to operate them.

In Paris, where prepayment meters are unknown, they yet have rigidly enforced regulations governing meter positions. No meter may be installed in a lavatory or bathroom and no meter may be so mounted that a reader has to use a step-ladder or go down on his knees to read it.

An Englishman's home is his castle, however, and if a consumer prefers to have his meter in the cupboard under the stairs or in the coal cellar where it suffers periodical interment, that is where it is often put.

In America, the outdoor mounting of meters, originally practised to combat meter diversion, was found to provide attractive economies in meter reading costs and is widely used. Experiments are being made to test the possibility of its adoption in certain localities in this country.

D.S.I.R. GRANTS

LONGER-TERM grants for special researches will be awarded by the Department of Scientific and Industrial Research in future. These grants—which have normally been limited to a maximum of five years—may now be awarded for an initial period of up to seven years with the possibility of continuing support for a further ten years. The first closing date for applications is 1st March next.

This change in policy has been made to meet present-day needs. The more complex and expensive researches may require support for more than five years to become fully established. When fully established the support for these researches will be transferred from D.S.I.R. to the university. The Department is therefore willing to support for longer periods outstanding university investigators embarking on promising researches for which their universities are unable to make adequate provision. Details of the scheme are contained in the 1959 edition of "Notes on D.S.I.R. Grants," published by H.M. Stationery Office.

Corrosion Probes in Flue Gases

TWO papers read before the Institute of Fuel on 4th February concerned the assessment of flue-gas corrosion of air heaters and economisers and cooler surfaces of power station boilers. One, by Dr. D. Anson (Shell Research, Ltd.), described the design and performance of a prototype internally cooled probe by means of which metal lost could be estimated by a count of radioactivity of the probe washings. Accurate results were reported to be obtainable within ten minutes of exposure and counting times of two minutes. Only a few elementary precautions were regarded as necessary to avoid health hazards. The development of a probe on this principle to give a continuous indication of corrosion was suggested.

The subject of the other paper, by Mr. R. W. Kear (Shell Petroleum Co., Ltd.), was a probe capable of operating at constant temperature for long test periods with a minimum of attention compared with earlier designs. Its scope for full-scale and laboratory-scale boiler investigations was discussed.

GENERATION and DEVELOPMENT

C.E.G.B. Contracts

The Central Electricity Generating Board has placed contracts during the past month for power stations, transmission lines and transforming stations amounting in the aggregate approximately to £5,984,000. They include the following:—

Acton Lane "B" power station: Vibratory dust conveying plant.—Mitchell Engineering.

Northfleet: Structural steelwork for conversion to coal firing.—Redpath Brown & Co.

Richborough: Two 120 MW turbo-generators.—Richardsons Westgarth (Hartlepool).

Rheidol: 33 kV switchgear and generator protection.—Cooke & Ferguson.

High Marnham: Telecommunication equipment and associated apparatus and cables.—Standard Telephones & Cables.

Skelton Grange "B": One 144 MVA, 132 kV generator transformer.—Hackbridge & Hewittic Electric Co. 415 V auxiliary switchgear and accessories.—Brookhirst Switchgear.

Blyth "B": Steel frame for turbine house and boiler house buildings.—Cleveland Bridge & Engineering Co.

Bankside-Battersea/Deptford: 132 kV and 66 kV cables.—British Insulated Callender's Cables.

Lynes Common substation: Two 30 MVA, 132/11 kV transformers.—Johnson & Phillips.

Marchwood-Langley: 132 kV overhead line.—Watshams.

Feckenham substation: 275 kV switchgear.—English Electric Co.

Dowlais-Hirwaun, and Keadby-Scunthorpe North: 132 kV double-circuit overhead lines.—Balfour Beatty & Co.

Keadby substation: 132 kV switchgear.—A. Reyrolle & Co.

Thames crossing-West Thurrock: 275 kV double-circuit overhead line crossing.—British Insulated Callender's Construction Co.

Rewiring of Pre-War Houses

The borough surveyor of Bexhill has reported that 90 per cent of the gas services and 40 per cent of the electrical installations in the Council's pre-war houses require renewal and has been authorised to proceed with this work.

At Maidstone the Housing Committee has approved in principle a programme of re-wiring spread over the next eight years. In the financial year 1959-60 it is proposed to carry out individual tests in 150 houses on the Foster Clark estate and where necessary to renew the wiring.

Electricity Supply Film

To give the public a better understanding of the problems which constantly face the electricity supply industry, the Central Electricity Generating Board has produced a film, "Colin Wills Reports on Electricity," a Press preview of which was given last week at the British Council Theatre in London. In it a number of well-known personalities in the industry—Sir Christopher Hinton, Lord Citrine, Sir Josiah Eccles, Mr. A. R. Cooper and others—answer many of the questions frequently asked by the public on financial, technical and amenity aspects of the Board's activities.

The reasons for the grid and super-grid are explained and it is shown that, in planning the routes of new lines, the Board consults with the various organisations interested in preserving the beauty of the countryside as well as with farmers, landowners and others. Thus a line which could be constructed in six months may take up to two years to complete. In another part of the film viewers are able to see how, with the aid of the grid, additional power is provided for an area where, because of a sudden storm, the electrical demand has exceeded the capacity of the local plant.

Progress with the construction of nuclear power stations is also illustrated and on the applications side it is shown that electricity is revolutionising industrial methods, bringing new labour-saving devices into the home and helping to reduce air pollution.

The film, which has been made for the Board by World Wide Pictures, Ltd., is available in 33 and 16 mm sizes from the Public Relations Branch, Central Electricity Generating Board, Winsley Street, London, W.1.

New Hornchurch Substation

A new substation which will provide Hornchurch with its first 33 kV supply within the boundary of the local Council was recently switched into service by Councillor G. W. Phillips, the chairman of the Council. Hitherto the h.v. network in Hornchurch has been at 11 kV and the 33 kV supplies have been drawn from Romford and from the Chequers substation, Dagenham. The new substation will be capable of meeting the bulk demands of Hornchurch over the next few years and will also improve the supply in some districts within the area. The building is heated by block thermal storage heaters.

Speaking afterwards to members of the Council, Mr. H. D. B. Wood, deputy chairman of the Board, said that that one of the problems of the industry was that it was difficult to get enough capital to cover both new development and reinforcement. In Essex this difficulty was accentuated by the presence of the new towns of Harlow and Basildon and by certain overspill schemes. Indeed, during nine of the ten years of nationalisation their capital expenditure had been the subject of one form of restriction or another. The Board hoped that by advertising and by the inducement of hire-purchase they could build up their load so that they could finance a still greater use of electricity.

OVERSEAS

Nuclear Plant for British Guiana?

According to a message from Barclays Bank D.C.O. in Georgetown, a representative of the Mitchell Engineering Group of the United Kingdom has been having talks with the British Guiana Government on the question of supplying a nuclear electricity plant. The plant would have an initial capacity of 17,500 kW with a reserve capacity of 4,500 kW. The approximate cost is said to be W.I.$15 million. It is said that this type of plant could generate electricity, inclusive of all costs, at a favourable figure and that the plant would be much cheaper to install than any other type.

Queensland Authority's Operations

The Southern Electric Authority of Queensland, which serves an area of some 20,000 sq miles around Brisbane, commissioned no additional plant during the year covered by its latest report (to 30th June last) but good progress was made on the installation of a further 30 MW set at the Bulimba "B" station. A photograph in the report shows the 90 ton stator of this Parsons turbo-alternator being unloaded at Brisbane. This plant is scheduled for service during the current year, and will be followed by another similar extension. Of the 728 million kWh generated last year nearly 516 million kWh was produced at Bulimba "B" where the more efficient plant helped to improve the overall efficiency from 22·98 to 23·58 per cent.

Continued work was carried out on the expansion and reinforcement of the 110 kV transmission system, some of it under difficult conditions. In one case the conductors had to be hauled across a 4,000ft gorge. It is proposed to make a start soon on increasing the size of conductors on the three main 110 kV feeders between Bulimba and Abermain. Much greater use is now being made of steel-cored aluminium conductors instead of copper.

Sales last year increased by nearly 8 per cent to 594 million kWh and an additional 5,381 consumers were connected, making the total number 117,662. There were no tariff increases during 1957-58. A net surplus of £355,174 on the year's operations has been transferred to reserve.

Financial Section

STOCKS and SHARES

THE City waits with interest to see the consequences of the Government's decision to suspend most of the official controls on new industrial capital issues. Nothing approaching a spate is anticipated. For some months the authorities have been refusing very few applications for permission to raise money in the market. Neither has there been much evidence that industry as a whole has been starved of capital, especially since the ending of restrictions on bank loans. It is most probable that the principal moves to take advantage of the new freedom will come from comparatively smaller enterprises which have felt hitherto that their plans had little chance of qualifying for the Capital Issues Committee's approval.

Industrial Markets

The Stock Exchange industrial markets have continued to move uncertainly. Activity has been no more than moderate, and the support for industrial shares has had some difficulty in contending with occasional spells of profit-taking induced by uncertainty about General Election prospects and the Berlin problem. Shares of the leading electrical groups have been reasonably firm, with English Electric a fraction harder at 58s 9d, after rising to 60s. Parsons and Reyrolle recovered strongly. In the radio group, Decca "A" regained 2s 6d, to 37s 6d, on further consideration of the previously announced increases in profits and dividends, while Cossor were active, and 6d higher at 7s 6d.

Thorn Electrical Industries

A persistent demand for the 5s shares of Thorn Electrical Industries has taken the price up to 30s (with the "A" shares at 25s 9d) since confirmation of the agreements with the Philco Corporation of America, under which Thorn gain access to the latter company's engineering knowledge and designs. On the basis of the 17½ per cent dividends paid for the last two years, the yield on the Thorn shares is now under 3 per cent, a return which reflects, in part, the conservatism of the dividends and partly also, no doubt, the strength of investment confidence in the future of the business. Assessments of the shares take into account the company's other transatlantic connections, especially the long established agreements with Sylvania Electric Products, and in the home market the addition of H.M.V. and Marconiphone to its own range of Ferguson radio and television equipment since last year's arrangements with Electric & Musical Industries. The company's financial year ends in March.

Electrical Components

The price of Electrical Components 5s shares has been lifted from 10s 9d to 11s 6d since the announcement of an increase from 5 to 6 per cent in the interim dividend for the year ending next March. For the previous year the distribution was brought up to a total of 12½ per cent and was well covered by earnings equivalent to

Price Changes in

Company or Board	Nom. Value	Middle price 9th Feb.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1958 Highest	1958 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	80	+½	3	3	3 15 0	77	72
Brit. Elec. 1974/77	100	76x.d.		3	3	3 19 0	73½	68½
Brit. Elec. 1976/79	100	80	+½	3½	3½	4 7 6	78½	72
Brit. Elec. 1974/79	100	90	+½	4½	4½	4 14 6	87½	82½
Overseas Electric Supply								
Calcutta Elec.	£1	16/-	−1/-	6·8†	7†	15 4 0	17/6	15/-
East African Power	£1	21/6		7½	8	7 8 9	23/-	17/6
Nigerian Elec.	£1	15/-		10	10	13 6 9	17/-	12/6
Perak Hydro-Elec.	£1	13/6		12½	10	14 16 3	15/6	13/6
Electrical Shares								
Aberdare Holdings	5/-	15/9		17½	17½	5 11 0	15/9	9/9
Aerialite	1/-	8/-		51½	54	6 15 0	8/6	5/1
Allen, W. H.	£1	43/9		10	11	5 0 6	43/9	32/9
Anglo-Portuguese Tel.	£1	28/9	+6d	8	9	6 5 3	29/3	19/9
Aron Elec. Ord.	£1	61/3		15	15	4 18 0	61/3	53/-
Assoc. Elec. Ord.	£1	55/-		15	15	5 9 0	58/9	46/6
Automatic Tel. & El.	£1	80/-		17	17	4 5 0	75/-	57/-
Babcock & Wilcox	£1	48/9	+1/9	15	13‡	5 6 6	54/6	41/9
Bakelite	10/-	22/9		15	15	6 11 9	23/-	17/6
Baldwin, H. J.	2/-	2/6		20	20	—	3/9	2/6
Berry's Electric	5/-	11/-		10	10	4 11 0	11/3	5/9
Bowthorpe Holdings	2/-	12/-		37½	25*	4 3 4	11/9	6/6
British Elec. Traction: Def. Ord. "A"	5/-	37/6	+6d	25	25	3 6 9	40/-	19/6
B.I. Callender's	£1	48/6	+1/9	12½	12½	5 3 0	52/-	38/9
B.I. Callender's 6% Pref.	£1	20/-		6	6	6 0 0	20/3	19/-
British Thermostat	5/-	38/9	+1/3	25	30	3 17 6	36/3	19/9
British Vac. Cleaner	5/-	6/6	+1/3	10	7½*	5 15 6	4/6	2/3
Brook Motors	10/-	50/-		25	24½*	4 16 9	45/-	27/9
Bulgin, A. F.	1/-	7/3		40	45	6 4 3	7/-	4/7
Bulpitts	5/-	10/6		—	12½‡	5 19 0	11/-	7/3
Burco Dean	5/-	12/6		22½	16*	6 8 0	12/6	7/9
Cable & Wireless: Ord.	5/-	13/-		10	10‡*	3 17 0	13/-	8/-
4% Loan	100	95		4	4	4 4 3	94½	89
Chloride El. Storage "A"	£1	67/-	+9d	17½	17½	5 4 6	68/9	55/6
Clarke Chapman	£1	62/6		27½	27½	4 8 0*	72/6	55/-
Cole, E. K.	5/-	18/9	+9d	17½	17½	4 13 3	18/-	15/3
Cossor, A. C.	5/-	7/6	+6d	2½	Nil	Nil	7/9	4/4
Crabtree	10/-	29/6	+6d	20	20	6 15 6	32/-	24/4
Crompton Parkinson	5/-	12/6		16	12*	4 16 0	13/9	8/3
Davis & Timmins	5/-	15/-		22½	18	6 0 0	16/3	10/3
De La Rue	10/-	32/6		35	17½*	5 7 9	34/-	20/9
Decca "A"	4/-	37/6	+2/6	43½	50	5 6 9	37/6	21/3
Desoutter	5/-	19/9		32½	18½*	4 15 0	19/3	13/6
Dewhurst	2/-	7/6		20	20	5 6 9	9/3	6/9
Dictograph Tel.	2/-	7/6		20	20	5 6 9	7/3	4/7
Dubilier Condenser	1/-	3/6		30	20*	5 14 3	4/3	3/1
Duport	5/-	10/3		25	12½*	6 2 0	10/9	7/9
E.M.I.	10/-	51/6	−2/6	15	20*‡	3 17 9	52/6	20/9
Electrical Components	5/-	11/6	+9d	12½	12½	5 8 9	10/9	7/-
Elec. Construction	£1	28/9		8½	8½	5 18 3	28/9	21/-
Elliott-Automation	5/-	17/6		—	10‡	2 17 3	19/9	11/6
Enfield Cable Ord.	£1	21/3	+1/3	Nil	2½	2 7 0	18/9	10/9
English Electric	£1	58/9	+3d	14	14	4 15 3	60/-	44/-
English Electric 3½% Pref.	£1	12/6		3½	3½	6 0 0	12/6	11/9
Ericsson Tel.	5/-	26/3		22†	12*‡	3 17 6	26/3	17/6
Ever Ready	5/-	24/9	+1/3	37½	20*	4 0 9	22/3	13/9
Falk Stadelmann	£1	42/6		17½	15	7 1 3	46/3	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

about 44 per cent on the ordinary capital ranking. Referring to dividend policy in the last annual report, the chairman pointed out that the change in the rate of profits tax brought no direct benefit to the company, but added that in future the directors need not feel restricted by the thought that any increase in the dividend would involve a heavy tax penalty. On the basis of last year's dividend the yield on the shares is about 5¼ per cent. On the last occasion the final declaration was made in July.

Electrical Investments

Company or Board	Nom. Value	Middle price 9th Feb.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1958 Highest	1958 Lowest
Electrical Shares—continued								
G.E.C.	£1	32/6		12½	10	6 3 0	40/-	29/3
G.E.C. 6½% Pref.	£1	21/-		6½	6½	6 3 9	21/6	20/3
General Cables	5/-	8/9	+6d	24	15	8 11 6	11/9	8/3
Greenwood & Batley	£1	80/6		17½	20	4 19 6	57/6	45/-
Hackbridge Holdings	5/-	15/3	+6d	20	20	6 11 3	15/3	7/6
Hackbridge & Hewittic	5/-	15/3		20	20	6 11 3	14/6	9/7
Head Wrightson	5/-	25/3		22½	17½*	3 9 3	26/-	16/9
Heatrae	2/-	8/9		15	20	4 11 6	7/9	4/-
Holophane	5/-	16/3	+3d	37½	22½*	6 18 6	15/6	12/6
Hoover	5/-	58/6	+2/-	50	50	4 5 6	58/6	31/-
I.C.I.	£1	34/6	+6d	10	12	4 12 9*	37/6	23/9
Intl. Combustion	5/-	31/3		22½	25	4 0 0	28/3	19/3
Intl. Computers & T.	£1	66/3	+3/9	—	8‡	2 8 3	—	—
Johnson & Phillips	£1	22/6	−3/3	10	5	4 9 0	25/-	15/-
Lancashire Dynamo	£1	42/6		11	11	5 3 6	45/-	28/6
Laurence Scott	5/-	17/3		15	15	4 7 0	16/9	12/6
Lister, R. A.	£1	33/6		10	12½	7 9 3	34/6	23/-
London Elec. Wire	£1	70/-		12½	12½	—	72/-	39/6
Lucas, J.	£1	44/6		7½	10‡	4 10 0	45/-	27/9
Marconi Marine	£1	47/6	+6/3	10	10	4 4 3	40/-	29/-
Marryat & Scott	2/-	9/-		35	37½	4 3 3*	8/9	5/3
Mather & Platt	£1	49/6	−1/-	15	15	4 0 9*	50/6	29/6
Metal Industries	£1	43/9		9	14	6 7 9	44/-	22/9
Midland Elec. Mfg.	£1	42/6		12½	10*‡	4 14 3	41/3	26/6
Morphy-Richards	4/-	18/9		20	20	4 5 3	20/-	14/6
Murex	£1	45/-	−6d	20	17½	7 15 6	59/3	46/9
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/3
Oldham & Son	1/-	2/6		17½	17½	7 0 0	3/-	2/3
Parsons, C. A.	£1	51/3	+3/9	8½	7½*	2 18 6	55/-	43/-
Plessey	10/-	72/6		30	30	4 2 9	72/6	55/-
Pye	5/-	14/3	+3d	12½	12½	4 7 9	17/-	10/-
Pyrotenax	5/-	35/-		—	27½‡	3 18 6	37/-	27/6
Reliance Clifton	5/-	17/6	−9d	13½	15	4 5 9	19/9	9/-
Rayrolle	£1	91/3	+3/9	17½	17½	3 16 9	93/9	73/6
Rheostatic	4/-	8/9		12½	12½	5 14 3	8/6	6/-
Richardsons Westgarth	10/-	14/9	+1/-	16½	8½*	5 13 0	15/9	13/-
Scottish Cables	4/-	15/3	+1/-	27½	27½	4 4 0*	12/3	7/-
Simon-Carves	5/-	29/6		20	25	4 4 9	31/3	22/6
Smith (England), S.	4/-	11/9		20	12½*‡	4 5 0	12/3	7/-
Southern Areas	£1	12/9	−1/9	7½	Nil	Nil	13/9	9/3
Strand Elec.	5/-	8/3		15	15	9 1 9	9/3	4/9
Sturtevant	5/-	17/3		15†	15†	7 12 0	19/6	14/9
Sun Elec.	£1	69/6	+3/3	25	25	7 4 0	60/6	47/3
Switchgear & Cowans	5/-	11/9	+1/3	25	22½	4 15 9*	9/9	4/6
Taylor Tunnicliff	5/-	18/3		15	17½	4 16 0	18/3	11/9
T.C.C.	10/-	39/-	−1/-	25	25	6 8 3	38/6	32/6
T.C. & M.	£1	36/3	+2/3	8½	8½‡	—	37/-	20/-
Telephone Mfg.	5/-	5/3		10	10	9 10 6	5/9	4/3
Telephone Rentals	5/-	15/6	+6d	12½	12½	—	14/6	9/9
Thompson (John)	5/-	23/9		25	25	5 5 3	27/-	23/-
Thorn Elec.	5/-	30/-	+1/9	17½	17½	2 18 3	25/-	17/-
Thornycroft	£1	21/3	−6d	12½	7½	7 1 3	30/9	21/-
Tube Investments	£1	78/9	+3/3	15	17½	4 9 0	81/3	48/3
Vactric	5/-	32/9	+2/9	25	25	3 16 3	—	—
Veritys	5/-	3/9		12½	2½	—	6/9	5/3
Walsall Conduits	4/-	17/3		20	22½	5 4 3	18/3	11/-
Ward & Goldstone	5/-	35/6	+3/6	40	25*	3 10 6	37/-	23/6
Watford	2/-	8/-	+3d	25	25	5 0 0*	8/-	4/-
Westinghouse	£1	41/3	+1/3	10	10	4 17 0	45/-	32/3
West, Allen	5/-	12/-		15	12½*	4 17 3‡	13/3	7/9
Wolf Electric	5/-	8/3		20	10*	6 1 3	9/-	6/9

Cables and Others

B.I.C.C. lost part of an advance to 50s, but retained a net gain of 1s 9d, at 48s 6d. Enfield Cable and Enfield Rolling Mills continued to attract a lot of attention as well as surmise; the former gained 1s 3d, to 21s 3d, while the latter fluctuated around 46s 3d. Scottish Cables were marked up by another 1s, to 15s 3d, but Johnson & Phillips lost 3s 3d, to 22s 6d. Philips Lamps crossed the £5 mark at one time, but came back to 96s 3d, and E.M.I. receded 2s 6d further to 51s 6d. Notable improvements took Ward & Goldstone up to 35s 6d, Vactric to 32s 9d, British Vacuum Cleaner to 6s 6d and I.C. & T. to 66s 3d. Babcock & Wilcox and Richardsons Westgarth reflected a harder tone in heavy engineering shares. Others to gain ground included Switchgear & Cowans, Hoover, Sun Electrical and Hackbridge Holdings.

Company News

After considerable fluctuations over the previous week or two, during which the price ranged between 12s and 14s 6d, Southern Areas 5s shares became steadier at around 12s 9d after a statement on the company's position and plans, which include the discontinuance of manufacturing at the ubsidiaries' Chalford and Birmingham works. It is expected that accumulated reserves will cover the terminal losses involved and that the outcome should be an improvement in the holding company's earnings and dividend prospects. Although trading profits for 1958 are estimated to have been similar to those of 1957 (when there was a surplus of £27,000, subject to tax) the net outcome cannot be predicted until a complex tax position has been resolved. No dividend was paid last year. The 5s shares of Veritys, for which company a winding-up petition is pending, have been dealt in recently at a little over 3s.

Television

Among the first big issues to be announced after the removal of Treasury control on capital issues will be a "rights" offer of shares, to raise about £4¼ million, by the Rediffusion company. Terms are to be fixed later. The shares were quoted subsequently at about 37s. The "A" shares of British Electric Traction, the other principal stockholder in Associated Rediffusion, have been firm at 37s 6d. There was little initial reaction to the publication of the Associated Television prospectus issued as a preliminary to the official quotation of the "A" ordinary shares, which have already been dealt in freely for some time under a special rule and have been quoted lately at around 70s. For the current year this company estimates a profit of over £5¼ million and indicates dividends totalling 100 per cent. Companies interested in this enterprise include Pye and Reliance-Clifton Cables

REPORTS and DIVIDENDS

Cable & Wireless (Holding), Ltd.—The accounts for 1958 show group profits of £1,302,000, as compared with £1,167,772 for 1957, and after providing £560,000 for taxation, the net profit is £742,000 (against £662,455). General reserve receives £290,000 and it is proposed to pay a final dividend of 2½ per cent, making 10 per cent for the year (unchanged) on increased capital.

Radio Rentals, Ltd.—The London and Yorkshire Trust announces that underwriting has been completed in connection with the issue to ordinary shareholders in Radio Rentals of 1,600,000 ordinary shares of 5s each at 15s per share. The new ordinary shares are being provisionally allotted to ordinary shareholders in the proportion of one new share for every five held. Shareholders will be given the opportunity to apply on a limited basis for shares not taken up.

Bruce Peebles & Co., Ltd., propose to make a two-for-one scrip issue and to split the £1 ordinary shares into 10s units. The directors state that the proposals do not indicate any intention of increasing the amount to be distributed as dividend. An extraordinary meeting is being held on 3rd April.

Electrical Components (Holdings), Ltd., has declared an interim dividend of 6 per cent (against 5 per cent) on larger capital.

Crabtree Electrical Industries, Ltd., has declared an interim ordinary dividend of 7½ per cent (unchanged).

New Companies

Cirmax Pumps, Ltd.—Registered 6th January. Capital £5,000. Manufacturers of electrical pumps; electrical engineers, electrical installation contractors, etc. Regd. office: Elland Lane, Elland, Yorks.

Lantech, Ltd.—Registered 2nd January. Capital £100. Electrical and mechanical engineers and contractors, makers of precision measuring instruments, etc. Regd. office: Winchester House, Old Broad Street, E.C.2.

Broughton & Irlam Electrical Engineering Co., Ltd.—Registered 5th January. Capital £10,000. Manufacturers of and dealers in radio, electrical and mechanical apparatus of all kinds, etc. Directors: J. Whiteley and Mrs. Elsie Whiteley. Regd. office: 393/5, Bury New Road, Salford, 7.

J. Bennett & Co., Ltd.—Registered 16th January. Capital £1,000. Electrical engineers, etc. Directors: J. P. Bennett and S. T. Nutt. Regd. office: 116a, Villa Road, Lozells, Birmingham.

G. Hollett & Co. (Electrical), Ltd.—Registered 19th January. Capital £1,000. Radio, television, telephonic and telegraphic and electrical engineers, etc. Directors: N. S. Shaw and W. G. B. Hollett. Regd. office: 57, Duke Street, Southport.

J. T. Wall, Ltd.—Registered 20th January. Capital £100. Radio, television, electrical and electronic engineers, etc. Directors: J. T. Wall and Lona C. Wall. Regd. office: 81, Barton Street, Tewkesbury.

Edwards & Son (Brighton 1959), Ltd.—Registered 16th January. Capital £2,000. Manufacturers of and dealers in and repairers and hirers of electrical and mechanical apparatus, etc. Directors: H. Jacobs, C. D. Franks and Nina Franks. Regd. office: 40, Ship Street, Brighton, 1.

Reynolds & Cutting, Ltd.—Registered 16th January. Capital £6,000. To acquire the business of electrical, radio and television engineers carried on at Liphook as Reynolds & Cutting, etc. Directors: N. F. Reynolds, D. F. Cutting and G. Child. Regd. office: 9, Headley Road, Liphook, Hants.

L. H. Carter (Electrical), Ltd.—Registered 21st January. Capital £100. Electrical engineers, etc. Directors: L. H. Carter and Beryl E. Carter. Regd. office: 20, Parkleigh Road, S.W.19.

D. W. Kennett (Electrical), Ltd.—Registered 21st January. Capital £100. Electrical engineers and contractors, radio and television engineers, etc. Directors: D. W. Kennett and Mrs. Doris F. Kennett. Regd. office: 11a, Rylett Crescent, W.12.

Ideal Home Domestic Electric Centre, Ltd.—Registered 21st January. Capital £1,000. Manufacturers of and dealers in domestic appliances, etc. Directors: R. E. Jennings, Thelma B. Jennings and S. J. Phillips. Regd. office: 416, Green Street, E.13.

Teloma, Ltd.—Registered 21st January. Capital £100. Merchants of, agents for and wholesale and retail dealers in radio, television and electrical apparatus, etc. Mrs. Ellen Keldon is the first director. Regd. office: Bristol House, 19/20, Holborn Viaduct, E.C.1.

Ledon Instruments, Ltd.—Registered 22nd January. Capital £1,000. Electricians, mechanical engineers and manufacturers of and dealers in electrical apparatus and goods, etc. Directors: L. E. Lubecki and D. Liddle. Regd. office: 2, Central Parade, Catford, S.E.6.

C.J.L. (Electrical), Ltd.—Registered 26th January. Capital £1,000. Electrical engineers and contractors, etc. C. J. Lally is first director. Regd. office: 37, Manchester Street, W.1.

Pyrad, Ltd.—Registered 23rd January. Capital £100. Manufacturers of and dealers in radio and television transmitting and receiving sets, recording apparatus, wire recorders, electrical and electronic devices and apparatus, etc. Directors: F. Keys, E. G. Hill and C. G. Reich. Regd. office: St. Andrews Road, Cambridge.

S.A.L. Electrical, Ltd.—Registered 27th January. Capital £100. Directors: G. S. Salariya and Jean Salariya. Regd. office: "Caircant," Blakeney, Glos.

Transistor Radio Co., Ltd.—Registered 26th January. Capital £100. Electrical engineers, radio manufacturers, etc. Directors: H. W. Barnett and L. F. Guillem. Regd. office: 32, Buckingham Palace Road, S.W.1.

Woodhouse & Parkin, Ltd.—Registered 7th January. Capital £2,000. Electrical engineers and contractors, etc. Directors: J. F. Woodhouse and R. Parkin. Regd. office: 51a, Bath Street, Ilkeston, Derbys.

B. & B. Teletubes, Ltd.—Registered 7th January. Capital £1,000. Manufacturers of and dealers in high vacuum tubes and all thermionic devices, etc. Directors: W. J. Clements and B. G. Holt. Regd. office: 7, Park Street, Stockport.

Charles K. Manley, Ltd.—Registered 31st December. Capital £5,000. To acquire the business of an electrical contractor carried on by C. K. Manley, at Heath, Cardiff, as "Charles K. Manley," etc. Directors: C. K. Manley (permanent), Gwen Manley, D. C. Manley and J. M. Manley. Regd. office: 110, King George V Drive, Heath, Cardiff.

Sydney G. Miller, Ltd.—Registered 18th November. Capital £100. Electrical, radio, television and mechanical engineers, etc. Directors: S. G. Miller and Mrs. Lena M. Miller. Regd. office: 35, Fore Street, Totnes, Devon.

Glodue, Ltd.—Registered 9th January. Capital £100. Light engineers, electrical, general and mechanical engineers, etc. Directors: Mrs. Doris E. Pope and R. E. Davids. Solicitors: Wedlake, Letts & Birds, 6, Stone Buildings, Lincoln's Inn, W.C.2.

General Illuminations Co., Ltd.—Registered 28th January. Capital £1,000. Manufacturers of and dealers in neon advertising and lighting signs; electric lighting specialists, etc. Regd. office: 6th Floor, 40/42, Oxford Street, W.1.

Midmag Electrical Manufacturing Co., Ltd.—Registered 28th January. Capital £1,000. Electrical and general engineers and manufacturers and factors of and dealers in all kinds of electrical and other machinery, plant, equipment and tools, etc. Directors: G. B. Pike and J. F. Hensman. Regd. office: Equipment Works, Alma Street, Aston, Birmingham, 6.

Avon Electrical (Heanor), Ltd.—Registered 28th January. Capital £1,000. Electrical equipment specialists, etc. Directors: Miss Margaret Johnson and J. E. Holland. Regd. office: Central Chambers, Red Lion Square, Heanor, Derbys.

Piccadilly Electrical Appliances, Ltd.—Registered 28th January. Capital £2,000. Manufacturers of and dealers in all kinds of domestic appliances, etc. Regd. office: 8, Spring Street, W.2.

White & French, Ltd.—Registered 29th January. Capital £2,000. Electrical engineers and contractors, etc. Directors: A. White (chairman) and G. French. Regd. office: 32, Green Street, Sunderland.

D.J. Equipment (Hersham), Ltd.—Registered 29th January. Capital £500. Electrical and mechanical engineers, etc. Directors: D. L. M. Jones and L. H. S. Ellis. Regd. office: 43, Queens Road, Hersham, Surrey.

Liquidations

Radio & Electrical Mantel Co., Ltd.—Winding up voluntarily. Liquidator, Mr. D. A. Draper, 51-52, Chancery Lane, London, W.C.2, appointed 9th January.

Champion Electric Sales (Export), Ltd.—Meeting 6th March at 90, Queen Street, London, E.C.4, to receive an account of the winding up by the liquidator, Mr. D. J. Martin.

Electrical Supplies Co. (Manchester), Ltd.—Winding up voluntarily. Liquidator, Mr. W. H. Lambert, 24, Brazennose Street, Manchester, 2, appointed 19th January.

Bankruptcies

P. Thomas, lately carrying on business at 4, New Street, Ledbury, Herefordshire, radio and electrical engineer.—Last day for receiving proofs for dividend 14th February. Trustee, Mr. W. H. Haigh, Official Receiver, Somerset House, 37, Temple Street, Birmingham, 2.

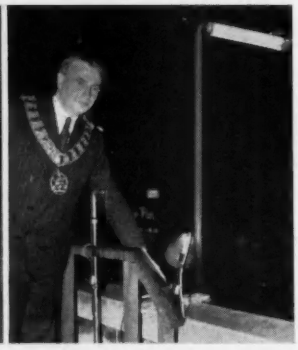
F. W. Mason, trading as F. W. Mason & Son, at 20, Shamrock Avenue, Ipswich, electrical contractor and radio and television engineer.—Third and final dividend of 2d in the £, payable on and after 17th February at Archdeacons House, Northgate Street, Ipswich.

F. Simons, 15, The Council House, Winchcombe Road, Sedgeberrow, Evesham, Worcs., electrical contractor.—Second and final dividend of 5s in the £, payable on and after 19th February at 126, Colmore Row, Birmingham, 3.

G. R. Overton, Rockland All Saints, Attleborough, Norfolk, radio and electrical engineer.—Receiving order made 29th January on debtor's own petition.

C. Worsley, merchant-convertor, 56, Faulkner Street, Manchester, and formerly also carrying on business at that address under the style of Happy Service Co., as an electrical goods retailer.—Public examination 10th April at the Court House, Quay Street, Manchester.

J. W. Luker and **H. A. R. Phillips,** lately carrying on business in partnership at East Street, Lewes, Sussex, and at 206, High Street, Lewes, under the style of Gordon & Luker, electrical contractors.—Supplemental dividend of 3¾d in the £, payable at the Official Receiver's office, 8, Old Steine, Brighton, 1.



Above: New fluorescent street lighting installed by the Revo Electric Co. at Acton, with the Mayor (Ald. C. T. Higgins) switching-on the first section

Street Lighting Modernisation

DURING 1957 Acton Town Council decided to re-light the whole of the borough at a total cost of approximately £170,000 and contracts were subsequently placed with the Revo Electric Co., Ltd., for Group "A" lighting of traffic routes, with Group "B" lighting for all the remaining roads. Street lighting in the borough has hitherto been mainly by gas.

The first section of the Group "A" scheme was recently brought into operation by the Mayor (Alderman C. T. Higgins) at an official switching-on ceremony at the Town Hall.

This scheme consists of 110 fluorescent lanterns throughout the main shopping centre, and sodium lighting for the remaining traffic routes. The fluorescent lanterns are the new Revo C.15076 "Sol-Etern" type, each accommodating three 80 W lamps. The 640 sodium lanterns are type C.15154 "Sol-Dor" units, each fitted with one 140 W sodium lamp and mounted on tubular steel columns. All control gear in the base of the columns is mounted on detachable metal trays connected to the mains supply and to the lamp by means of a plug and socket, thus allowing for quick and easy servicing and replacement. Fluorescent control gear is of the Revo polyester switchless start type recently introduced by the company.

The Group "B" installation consists of approximately 1,875 type C.15116 "Post Top" fluorescent lanterns, each fitted with two 40 W lamps and 225 type C.15152 sodium lanterns fitted with one 60 W sodium lamp. In both cases the lanterns are mounted on Revo "Council" columns. A similar arrangement for easy servicing of the ancillary gear is adopted as for the Group "A" installation.

The switching arrangements are by individual Venner time switches, those on the Group "A" installation being equipped with a synchronous motor and spring reserve, and the Group "B" scheme is controlled by synchronous motor driven types.

Both schemes were prepared by the Borough Engineer and Surveyors' Department under the direction of Mr. S. W. Slight, and the whole of the equipment is being installed by Revo Erection Department.

Great West Road Lighting

A new street lighting installation of 326 lanterns, each housing colour modified 400 W Osram mercury (MBF/U) lamps, has been installed along the sections of the Great West Road and Great South-West Road within the borough of Heston and Isleworth.

The General Electric Co., Ltd., has supplied lanterns, control gear, lamps and Stewarts & Lloyds steel columns, and the installation, including the modification of over 200 existing columns to accommodate new lanterns, was carried out by the company's mobile erection squad. The type of lantern chosen for the new installation, the G.E.C. Z8430CM, incorporates an optical system designed specially to control the light from (MBF/U) mercury lamps. It has a body of die-cast light alloy designed to give a pleasant daytime appearance and provide a high resistance to corrosion.

The new installation was planned by the borough engineer for Heston and Isleworth, Mr. T. A. Lawton.

G.E.C. colour corrected mercury lighting along the Great West Road. Right: The Mayor of Heston and Isleworth switches on the last lamp at a ceremony on 20th January; Mr. D. Hart, manager of G.E.C. Exterior Lighting Section, is on the right

Lighting Plans

Airdrie Town Council is to go ahead with its scheme to make the town's street lighting all-electric and is including £4,950 in the 1959-60 estimates for the first stage of conversion. The total cost is estimated at £45,585.

Barrow-in-Furness Highways Committee is applying for sanction to borrow £10,500 for converting the lighting in a further area of the borough from gas to electricity.

Carlisle City Council has agreed on a policy of replacing gas street lamps with electric lighting. The cost will be about £84,000. It is proposed to spend £5,000 on the work annually until the project is completed.

Colwyn Bay Corporation has approved the preparation of a scheme, estimated to cost £80,000, for the replacement of the town's gas street lighting by electricity.

Crewe Town Council is to modernise street lighting in the borough during the next three years at an estimated cost of between £30,000 and £40,000.

Fulham Works and Highways Committee has recommended an expenditure of £20,000 on the first stage of the side street lighting improvement programme to be carried out within the next twelve months.

Ripon City Council has approved a scheme submitted by the city engineer for improved lighting in various streets, at an estimated cost of £6,968.

Salford City Council is recommended to seek sanction to borrow £27,515 for the improvement of street lighting.

Shipley Highways and Building Committee has approved an estimate for the conversion of all the remaining gas street lighting in the town by the provision of 1,305 electric lamps at a cost of £33,930.

Sunderland Town Council has approved a scheme for changing over from gas to electric street lighting at Fulwell.

Swansea Highways Committee is to submit to the Minister of Transport and Civil Aviation for approval a scheme for provision of sodium lighting along main roads and bus routes. The estimated cost is £20,000.

Walsall Public Works Committee recommends that the borough surveyor should be authorised to re-light various residential roads in the borough at an estimated cost of £16,000.

Warmley Finance and General Purposes Committee has recommended a £5,130 scheme for the improvement of street lighting. It is proposed to link up with the lighting of Mangotsfield (Glos.).

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1945

32814. Seaborg, G. T., Gofman, J. W., and Stoughton, R. W.—Nuclear reactors. 4th December, 1945. (808803.)

1951

11607. Minister of Supply.—Radio navigational apparatus. 16th May, 1952. (808830.)

1954

4825. Pye, Ltd.—Apparatus for the manufacture of piezo-electric crystal oscillator or filter plates. 16th May, 1955. (808804.)

8145/6. Young, S. G.—Clamps for securing electrical conduits to wall boxes. 20th June, 1955. (808897/8.)

30799. Electric & Musical Industries, Ltd. —Apparatus for measuring attenuation at radio frequencies. 25th October, 1955. (808761.)

1955

52. C.N.S. Instruments, Ltd.—Induction generator for use in d.c. circuits wherein a potentiometer is adjusted by an error signal. 3rd April, 1956. (808883.)

5136. Kabelschlepp G.m.b.H.—Electrical plug and socket connectors. 21st February, 1955. (808916.)

14847. Krawinkel, G. H.—Electrostatic devices. 23rd May, 1955. (808764.)

14978. General Electric Co.—Semiconductor devices. 24th May, 1955. (808840.) 36075. Production of semiconductor bodies. 12th November, 1956. (808813.)

15740. General Electric Co.—Light projecting systems. 1st June, 1955. (808841.)

21329. General Electric Co., Ltd.—Electric transformers. 23rd July, 1956. (808625.)

30742. Westinghouse Brake & Signal Co., Ltd., Langridge, A., Hunter, D. J., and Greenwood, H. W.—Manufacture of containers for small electrical components. 25th September, 1956. (808766.)

33740. British Thomson-Houston Co., Ltd.—Electromagnetic pumps. 15th November, 1956. (808845.)

36107. International Business Machines Corporation.—Electromagnetic eraser. 16th December, 1955. (808658.)

37414. Standard Telephones & Cables, Ltd.—Processes for connecting wires to printed circuits. 30th December, 1955. (808814.)

1956

840. Philips Electrical Industries, Ltd.— Circuits for generating stabilised pulsatory voltages. 10th January, 1956. (808768.)

4540. Teszner, S.—Unipolar field-effect transistor. 14th February, 1956. (808734.)

5606. Etablissements Merlin & Gerin.— Circuit-breakers with magnetic blow-out. 23rd February, 1956. (808772.)

5634. Celanese Corporation of America.— Electromagnetic traverse mechanism. 23rd February, 1956. (808850.)

6797. Revo Electric Co., Ltd.—Electric switches having interlocked covers. 1st March, 1957. (808628.)

7300. Marconi's Wireless Telegraph Co., Ltd.—Frequency discriminators. 7th November, 1956. (808921.)

7307. British Thomson-Houston Co., Ltd. —Time base circuit arrangements employing transistors. 26th February, 1957. (808663.)

12042. Santon, Ltd.—Rotary electric switches. 23rd April, 1957. (808923.)

12086. Plessey Co., Ltd.—Charging device for electrometers. 12th April, 1957. (808630.)

13184. Philips Electrical Industries, Ltd. —Electroscopes for radiation detection. 30th April, 1957. (808775.)

13825. Westinghouse Electric International Co.—Electrical time delay apparatus. 4th May, 1956. (808924.)

14340. United Aircraft Corporation.— Force ratio transducer. 9th May, 1956. (808886.)

17970. General Electric Co.—Dynamo-electric machines. 11th June, 1956. (808858.)

17979. Wharton, J. H.—Television receiving apparatus. 27th March, 1957. (808671.)

19488. General Electric Co., Ltd., Griffith, G. W. S., and Hickin, E. M.—Aerial assemblies. 20th September, 1957. (808961.)

21641. Automatic Telephone & Electric Co., Ltd.—Loading coil pots. 11th June, 1957. (808672.)

22817. Automatic Telephone & Electric Co., Ltd.—Signalling devices. 7th June, 1957. (808929.)

24423. Metropolitan-Vickers Electrical Co., Ltd.—Operation of on-load transformer tap changers. 31st July, 1957. (808968.)

26025. Sulzer Freres S.A.—Forced-flow once-through steam generators. 24th August, 1956. (808819.)

26043. Sperry Rand Corporation.—Pulse translating system. 24th August, 1956. (808677.)

26083. Electric Storage Battery Co.— Electric storage battery plates. 27th August, 1956. (808640.)

26101. Standard Telephones & Cables, Ltd. (International Telephone & Telegraph Corporation).—Automatic echo pulse recapture circuit for tracking radar systems. 27th August, 1956. (808678.)

28111. Electrical Remote Control Co., Ltd., and Chuchla, J.—Automatic control systems for electric alternators. 14th September, 1956. (808643.)

28335. Imperial Chemical Industries, Ltd. —Electric switches. 23rd August, 1957. (808864.)

29239. Parkinson Cowan, Ltd.—Domestic clothes washing machines. 3rd October, 1957. (808644.)

29336. Colne Switchgear (K. & W.), Ltd. —Electric contact, contactors or switches. 25th September, 1957. (808747.)

30789. General Electric Co., Ltd.— Vitreous-to-metal pinch seals. 5th September, 1957. (808933.)

32757. Pechiney Compagnie de Produits Chimiques et Electrometallurgiques.—Apparatus for the remote control of electrode holders. 26th October, 1956. (808866.)

33716. Collins Radio Co.—High input impedance comparator. 5th November, 1956. (808687.) 34712. Fading electrical circuit. 13th November, 1956. (808868.)

34740. Sarpsborg Elektriske Fabrikker, Sefa A.S.—Electric bed heater. 13th November, 1956. (808939.)

37780. National Cash Register Co.—Magnetic core switching circuitry. 11th December, 1956. (808752.)

38079. Square D Co.—Ambient temperature compensated electrical switch. 13th December, 1956. (808962.)

38290. Standard Telephones & Cables, Ltd.—Regulated power supply systems. 14th December, 1956. (808790.)

38824. Marconi's Wireless Telegraph Co., Ltd.—Very short wave aerials. 16th August, 1957. (808941.)

39352. Yardney International Corporation.—Arrangement for controlling the electrolyte level in a battery or accumulator. 27th December, 1956. (808963.)

1957

2522. Ellenberger & Poensgen G.m.b.H. —Bi-metallic electric circuit-breakers. 23rd January, 1957. (808715.)

8460. Philips Electrical Industries, Ltd.— Irradiating devices. 14th March, 1957. (808795.)

29976. Modrey, H. J.—Electric wiring terminals. 12th April, 1955. (Divided out of 808697.) (808698.)

33620. Philips Electrical Co., Ltd.—Electric aerial cables. 28th October, 1957. (808896.)

Canadian Nuclear Power

Mr. J. Herbert Smith, president of the Canadian General Electric Co., Ltd., states in a summary of 1958 events in the Canadian electrical industry that there are several important areas in Canada, for example in Southern Ontario, in which nuclear power should become competitive within the next five to seven years. He notes that the company, with the Hydro-Electric Power Commission of Ontario and the Canadian Government, is at work on a distinctly Canadian nuclear power project. Canada favours the heavy-water moderated type of reactor which she has pioneered. The main advantage of this type, Mr. Smith says, is its low fuelling cost combined with freedom from the need for chemical reprocessing of spent fuel to recover unused uranium 235 and plutonium for financial credits. The Canadian design uses natural uranium, which opens up broad export opportunities.

In Canada, the Atomic Energy of Canada, Ltd., has established a new nuclear power plant division which is actively engaged in the design of a heavy-water cooled and moderated reactor rated at 200 MW known as "Candu" for use by Canadian industry and utilities. In the United States a new programme will concentrate on three reactor types—the boiling water, pressurised water, and the organic-cooled types.

The organic cooled interim reactor, known as OCDR, is based on the Canadian heavy-water moderator technology, but use of an organic coolant reduces pressures and therefore containment problems. Design and cost studies indicate that OCDR promises a significant reduction in capital costs while still maintaining the low-fuelling costs—natural uranium—inherent in heavy water moderator reactors.

Progress in the Canadian Electric-Ontario Hydro Commission-Canadian Government nuclear power demonstration reactor "NPD" has been excellent. Construction activities were resumed last summer. Rock excavation has been completed and the building superstructure is now being poured. The 20 MW prototype plant will be commissioned early in 1961. It will use natural uranium under conditions which will provide data on which fuel development and fuel performance guarantees may be based. Experience with NPD should prove a great aid in promoting the sale of both Canadian produced reactors and reactor fuel abroad.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

MONDAY, 16th FEBRUARY

Birmingham.—Grand Hotel. Birmingham Electric Club. "Education in Russia," by Dr. P. F. R. Venables.

Bristol.—S.W.E.B., Colston Avenue, 6 p.m. I.E.E. Western Supply Group. "Protection of Rural Networks," by F. G. Copland.

Cheltenham.—Rotunda, 7.30 p.m. Society of Instrument Technology, Cheltenham Section. "Instruments for Nuclear Reactors," by T. D. H. Andrews.

Hatfield.—Technical College, 7 p.m. I.E.E. Hatfield District. "Some Problems in the Design of a Missile Guidance System," by P. R. Fransk.

Ipswich.—Electric House, 7.15 p.m. Ipswich and District Electrical Association. "Medical Applications of Electricity," by L. E. Treliving.

Liverpool.—At the Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey and North Wales Centre. "Thermonuclear Processes," by D. W. Fry.

London.—At the Royal Institution, Albemarle Street, W.1. I.E.S. London Section. Trotter-Paterson Memorial Lecture, by Professor Sir Solly Zuckerman.

Dorchester Hotel, W.1, 7 for 7.30 p.m. Association of Consulting Engineers. Annual dinner.

Newcastle-on-Tyne.—King's College, 6.15 p.m. I.E.E. North Eastern Radio and Measurement Group. "A Method of Measuring Self-Inductances Applicable to Large Electrical Machines," by Professor J. C. Prescott and A. K. El-Kharashi.

Rutherford College of Technology, Northumberland Road, 7 p.m. Institution of Production Engineers, Northern Region. "Practical Application of Production Engineering Research," by Dr. D. F. Galloway.

Old Assembly Rooms. North East Electrical Club. Ladies' night.

Plymouth.—South Western Electricity Board, 7 p.m. I.E.S. Bath and Bristol Centre. "New Light Sources," by F. Jackson. (Joint meeting with E.C.A.)

Stafford.—Technical College, 7 p.m. I.E.E. North Staffordshire Sub-Centre. Discussion on "What is a Cultured Engineer?", opened by Dr. K. R. Sturley.

MONDAY, 16th FEBRUARY and TUESDAY, 17th FEBRUARY

London.—Savoy Place, W.C.2. I.E.E. Measurement and Control Section. Specialist discussion meetings on New Digital-Computer Techniques.

TUESDAY, 17th FEBRUARY

Arborfield.—Assembly Hall, 3 (Tels.) Training Bn., R.E.M.E., 7 p.m. I.E.E. London Graduate and Student Section. District meeting. "A Survey of Microwave Techniques for the Transmission of Speech and Vision," by K. C. Kao.

Cambridge.—Cavendish Laboratory, Free School Lane, 8 p.m. I.E.E. Cambridge Radio and Telecommunication Group. "Some Recent Developments in X-Ray and Electron Microscopy," by Dr. P. Duncumb.

Canterbury. — County Hotel, 8 p.m. A.S.E.E. East Kent Branch. Lecture.

Coventry.—Coventry Electricity Sports and Social Club, Merrick Lodge, St. Nicholas Street. Coventry Electric Club. "Atomic Research in the Nuclear Power Industry," by Dr. G. Horn.

Edinburgh.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South East Scotland Sub-Centre. "The Recognition of Moving Vehicles by Electronic Means," by T. S. Pick and A. Readman.

Farnborough.—Queens Hotel, 7.30 p.m. A.S.E.E. Aldershot and Districts Branch. "Railway Electrification," by D. B. MacKenzie.

Glasgow.—A.S.E.E. Glasgow Branch. Visit to Compressor Works, Allen & MacLellan (Polmadie), Ltd.

Leeds.—C.E.G.B., 1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilisation Group. "Electrical Installation at Calder Hall Nuclear Power Station," by N. J. Mackay and E. Hardwick.

Liverpool.—Merseyside and North Wales Electricity Board Industrial Development Centre, 6 p.m. I.E.S. Liverpool Centre. "Son et Lumière in Great Britain," by H. Hewitt.

Manchester.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North Western Measurement and Control Group. "A Train Performance Computer," by Professor E. Bradshaw, M. Wagstaff and F. Cooke.

Rugby.—College of Engineering Technology, 6.30 p.m. I.E.E. Rugby Graduate and Student Section. "Recent Developments in Electric Winders," by L. M. Read.

WEDNESDAY, 18th FEBRUARY

Bristol.—The University, 7 p.m. I.E.E. Bristol Graduate and Student Section. "Speed Changing of Squirrel Cage Induction Motors by Pole Amplitude Modulation," by W. Fong.

Edinburgh.—North British Hotel. Combustion Engineering Association Edinburgh Meeting. 10.30 a.m. "The Insulation of Industrial Buildings," by J. Lawrie; 2.30 p.m. "Case Histories of Fuel Savings," by H. H. Grattidge.

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio and Telecommunication Section. "Ultrasonic Iconoscopes," by C. N. Smyth and J. Sayers.

Middlesbrough.—Cleveland Scientific and Technical Institute, Corporation Road, 7.30 p.m. Society of Instrumental Technology, Tees-Side Section. "Development Reliability in New Machines: New Approach," by Dr. G. Morris.

Newcastle-on-Tyne.—At the Literary and Philosophical Society. I.E.E. North Eastern Centre. First Hunter Memorial Lecture on "P. V. Hunter—Electrical Engineering in our Time," by C. O. Boyse.

King's College, Stephenson Buildings, 7 p.m. Society of Instrument Technology, Newcastle Section. "Variable Area Flowmeters," by F. C. Whalen.

Nottingham. — Mechanics' Institution, Trinity Square, 7.30 p.m. A.S.E.E. Nottingham Branch. Annual films evening.

Portsmouth.—G.P.O. Automatic Exchange, Park Road, 6.30 p.m. I.E.E. Southern Centre. "G.P.O. Television Links," by T. Kilvington.

Preston.—North Western Electricity Board, 19, Friargate, 7 p.m. I.E.S. North Lancashire Group. "As I See It," by S. Mountain.

Sheffield.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "Electrification of the U.K.A.E.A. Industrial Group Factories," by J. W. Binns and W. J. Outram.

Grand Hotel, 7.30 p.m. Institution of Heating and Ventilating Engineers, Yorkshire Branch. "Development and Application of Underfeed Automatic Stoker," by K. Holdsworth.

Wolverhampton.—Chamber of Commerce, Lichfield Street, 7.45 p.m. A.S.E.E. Wolverhampton and District Branch. "Recent Changes in Routing and Charging of Telephone Calls," by H. L. Hitchin.

THURSDAY, 19th FEBRUARY

Chelmsford.—Hoffmann's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "The Microstructure of Metals," by Dr. J. Nutting.

Dublin.—Physical Laboratory, Trinity College, 6 p.m. I.E.E. Irish Branch. "Appraisal of the Factors Appertaining to Reliable Television and V.H.F. Coverage," by N. W. Mulcahy.

Glasgow.—39, Elmbank Crescent, 7 p.m. British Institution of Radio Engineers, Scottish Section. "True Motion Radar," by J. H. Beattie.

London.—76, Mark Lane, E.C.3, 2.30 p.m. Diesel Engineers' and Users' Association. "The Application of Diesel Engines to Automatically Controlled Power Plant," by K. L. Ives.

At the Royal Empire Society, Northumberland Avenue, W.C.2, 7 p.m. Institution of Production Engineers, South Eastern Region. "Planned Maintenance of Electrical and Mechanical Equipment in a Paper Mill," by C. A. Castle and D. W. Bexton.

Southampton.—Polygon Hotel, 7.15 p.m. Institution of Production Engineers, Southern Region. "Manufacture and Application of Junction Transistors," by E. Walfendale.

FRIDAY, 20th FEBRUARY

Cardiff.—At the South Wales Institute of Engineers, Park Place, 7 p.m. Institute of Marine Engineers, South Wales Section. "Nuclear Steam Propulsion for Merchant Ships," by W. R. Wootton.

Edinburgh.—The University, Drummond Street, 7 p.m. British Institution of Radio Engineers, Scottish Section. "True Motion Radar," by J. H. Beattie.

Liverpool.—University Club, 7 p.m. British Institution of Radio Engineers, Merseyside Section. "Electronic Welding Controls," by C. R. Bates.

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio and Measurement Sections. "The Measurement of Errors in Data Transmission for the Design of Detecting and Correcting Equipment," by V. J. Terry and E. P. G. Wright.

I.E.E. London Graduate and Student Section, 3 p.m. Visit to Dominion Theatre, Tottenham Court Road, W.C.1.

Marconi House, 336, Strand, W.C.2, 7 p.m. I.E.E. London Graduate and Student Section. Conversazione and dance.

Connaught Rooms, W.C.2, 12.45 p.m. Electrical Trades' Commercial Travellers' Association. Annual luncheon.

Connaught Rooms, W.C.2, 7.30 for 8 p.m. Institution of Plant Engineers. Annual dinner.

1, Birdcage Walk, Westminster, S.W.1, 6 p.m. Institution of Mechanical Engineers. Discussion on "Choice of Gas Temperature and Steam and Pressure Conditions in Nuclear Power Stations."

14, Rochester Row, S.W.1, 7 p.m. Junior Institution of Engineers. "The Selection and Use of Arc Welding Processes," by E. Flintham.

Manchester. — Engineers' Club, Albert Square, 6.30 p.m. Institution of Heating and Ventilating Engineers, Manchester and District Branch. "The Failure and Maintenance of Steam Boilers and Pressure Vessels," by C. W. Scarisbrick.

Newport (I. of W.).—S.E.B. Showrooms, 6.30 p.m. I.E.E. Southern Centre. "Installation of a B.B.C. Television Transmission Station," by E. P. Metcalf.

Nottingham.—Victoria Station Hotel, 7 p.m. I.E.E. East Midland Centre. Annual dinner-dance.

Stone.—Crown Hotel, 7 for 7.30 p.m. I.E.E. North Staffordshire Sub-Centre. Annual dinner.

SATURDAY, 21st FEBRUARY

London.—A.S.E.E. North West London Branch. Visit to Houses of Parliament.

Oxford.—St. John's Hall, Marston Street, 7 p.m. A.S.E.E. Oxford and District Branch. "Electric Floor Heating."

Teddington.—A.S.E.E. South East London Branch, 2 p.m. Visit to National Physical Laboratory.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—Western Australian Government Tender Board, Perth. 19th February. Six 1,000 kVA transformer units. (E.S.B. 3492/59. Ten/37245.)* Twelve 10 kVA and fifty 5 kVA transformers. (E.S.B. 3493/59. Ten/37246.)* Transformers ranging from 25 kVA to 500 kVA. (E.S.B. 3494/59. Ten/37238.)*

Snowy Mountains Hydro-Electric Authority, Cooma North, N.S.W. 25th March. Circuit-breakers, isolating switches, earthing switches, insulator stacks and current transformers for Upper Tumut switching station. (E.S.B. 2436/59. Ten/37105.)*

South Australian Railways, Adelaide. 16th March. 14, or alternatively 28, diesel engines, transmission and associated control equipment for suburban diesel rail cars. (E.S.B. 2151/59. Ten/36963.)*

Belfast.—Northern Ireland Housing Trust. 20th February. Electrical installation in the old people's welfare home and Dunmurry. McCandless & Barton, consulting engineers, 6, Murray Street, Belfast.

Brentwood.—U.D.C. 28th February. Electric lamps and fluorescent tubes (tender form No. 22), for the year ending 31st March, 1960. Engineer and surveyor, Council Offices.

Burma.—Burma Purchase Board, Rangoon. 23rd February. Fifty 12 V batteries. (E.S.B. 2978/59. Ten/37135.)* 26th February. Fluorescent canister starters, fuse bases and carriers. (E.S.B. 2977/59. Ten/37159.)*

Canada.—British Columbia Power Commission, Victoria, B.C. 24th February. Five 3,000 kW diesel generator sets. (E.S.B. 3101/59. Ten/37151.)*

Derby.—Corporation. 3rd March. Trunk road lighting equipment. (See this issue.)

Durham.—County Council. Electrical installation in new modern school. (See this issue.)

Edinburgh.—North of Scotland Hydro-Electric Board. Material for second circuit of Craigiebuckler 132 kV transmission line. (See this issue.)

India.—Uttar Pradesh Electricity Department, Lucknow. 15th April. Transformers, circuit-breakers, isolators, lightning arrestors and control gear for substations. (E.S.B. 3046/59. Ten/37146.)*

Andhra Pradesh Electricity Department, Hyderabad. 16th February. H.v. pin insulators. (E.S.B. 3467/59. Ten/37215.)* 18th February. Strain insulators and fittings. (E.S.B. 3468/59. Ten/37216.)*

Iraq.—Directorate General of Municipalities, Baghdad. 28th February. One 300 kW a.c. generating set. (E.S.B. 2376/59. Ten/37183.)* 14th March. Seventy-five transformers. (E.S.B. 3231/59. Ten/37181.)*

Kidderminster.—Borough Council. 27th February. Electrical installations in administration block, sale rings, traders' offices, cattle, pig and produce buildings and superintendent's house at the new cattle market. Borough engineer and surveyor, 110, Mill Street.

Korea.—Government Office of Supply, Seoul. 20th February. Radio transmitter and component parts. (E.S.B. 2538/59. Ten/37045.)*

London.—India Store Department. 16th March. Hot air circulating furnace for heat treatment. 23rd March. Cables. 132 kV and 25 kV disconnecting switches for Damodar Valley Corporation. (See this issue.)

Manchester.—Corporation. 23rd February. Transformers for new terminal building, Manchester Airport. 2nd March. Switchgear and switchboard for underground car park. (See this issue.)

New Zealand.—G.P.O., Wellington. 26th February. Electronic valves. (E.S.B. 2872/59. Ten/37102.)*

Salvador.—La Proveeduria General de la Republica, San Salvador. 19th February. Floodlighting equipment. (E.S.B. 3618/59. Ten/37287.)*

South Africa.—Stores Department, South African Railways, Johannesburg. 27th February. Rural carrier terminals. (E.S.B. 2624/59. Ten/37066.)* Six 75 Ah batteries and battery chargers. (E.S.B. 2962/59. Ten/37123.)*

Sunderland.—Corporation. 10th March. Electrical installation in Bede Grammar School extensions. (See this issue.)

Thorne.—Parish Council. 25th February. 15 steel lighting columns, together with lanterns and control equipment, for 140 W sodium vapour lighting, main road through village. Eric Searle, clerk, The Green, Thorney.

Wandsworth.—Borough Council. 25th March. Street lighting equipment. (See this issue.)

ORDERS PLACED

Bexley. — Corporation. Recommended. Sodium street lighting (£4,132).—Revo Electric Co.

Blackpool.—Education Committee. Relighting of Palatine School (£2,842).—A. Williams & Son.

Hebburn-on-Tyne.—U.D.C. Electrical installations in 57 houses, Finchale Road and Prendwick Avenue (£1,673).—N. Robinson & Co.

London.—Lewisham Housing (Management) Committee. Electrical work in 49 flats, 16 maisonnettes, seven houses and 17 garages at Honor Oak Road (£5,542).—Norwood Electrical Co.

Battersea Works Committee. Electrical installation work in 208 flats at Austin Road (£7,295).—Holliday, Hall & Stinson.

St. Marylebone Works Committee. Recommended. Three electrically driven trucks (£1,440).—Sidney Hole's Electric Vehicles.

Stockton-on-Tees.—Education Committee. Electrical installation in Roseworth Secondary Modern School (£7,294).—A. Rose, Ltd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Belfast.—Additions to school at Ardilea, Newtownabbey (£120,000); governors, Belfast High School.

Birmingham.—New headquarters building, Harborne Road, Edgbaston, for Chamber of Commerce (£500,000); Tersons, Ltd., builders, 4, Dollis Park, Finchley, London, N.3.

Factory, Barford Street; Collins & Broadbent, Ltd., 28, Longbridge Road, Birmingham, 12.

Bracknell.—Dairy for W. Clifford & Sons, Ltd., Harmondsworth; Dodge & Reid, architects, 72, High Street, Brentford.

Bristol.—Shop and office block, Baldwin Street/Queen Charlotte Street corner site; Site Improvements, Ltd., 1, Queen Anne's Gate, London, S.W.1.

Chippenham.—Houses (140), Bristol Road; Downing, Rudman & Bent, Ltd., builders, Old Road.

Dagenham.—Houses (79), Beamway, Rainham Road; K. Lauder, town clerk, Civic Centre.

Doncaster.—Church of St. Leonard and St. Jude; Robert Dunkeley & Sons, Ltd., builders, 9, Highfield Road.

Dunstable.—Factory on site near Town Centre; Hawthorn Baker, Ltd., engineers, Nicholas Lane, Dunstable.

Hindhead.—Flats, Thirlestane; Wakenhills, Ltd., 6/8, Sackville Street, London, W.1.

Houghton-le-Spring. — Houses (100); U.D.C. surveyor.

Huntingdonshire. — Secondary modern schools, Orton (£156,000) and Sawtry (£100,531); S. Holloway, county architect, County Buildings, Huntingdon.

Jarrow.—Houses (250); borough engineer.

Kettering.—Houses (130); borough surveyor.

Lancaster.—Laboratories and offices, Meadowside; Storey Bros. & Co., Ltd., White Cross Mills.

London.—Factory, Lambeth; Lansdale & Sons, Ltd., 11, Conquest Street, S.E.1.

Rebuilding Christ Church C.E. Primary School, St. Pancras (£58,584); E. G. Dodds & K. C. White, architects, 45, Queen Anne Street, London, W.1.

Loughborough.—Development of private estate with 120 houses and bungalows in grounds of Shelthorpe House; William Davis & Co. (Leicester), Ltd., Loughborough, Leics., builders.

Lytham St. Annes.—St. Bede's R.C. Secondary School; Charles E. Jackson, architect, 73, Harrington Avenue, Blackpool.

Manchester.—Eight-storey offices, Mosley Street/York Street corner site; Williams Deacons Bank, Ltd., Mosley Street, 2.

Newcastle-on-Tyne.—Extensions to police headquarters, Market Street (£97,000); M. J. Gleeson, Ltd., contractors, Sheffield.

Newry (Co. Down).—Proposed new hospital at Daisy Hill (£500,000); South Down Hospital Management Committee.

Northwich.—Memorial hall; Elleray & Wallace, architects, Chester Way.

Seaton Valley (Northumberland).—Houses at Cramlington (80), Seaton Delaval (70), and Shiremoor (28); U.D.C. surveyor.

Southport.—Phase II of Mental Deficiency Hospital, Greaves Hall; Liverpool Regional Hospital Board (Architects' Department), 88, Church Street, Liverpool.

Stockton-on-Tees. — Secondary modern school, Fairfield (£113,000); J. Miller & Partners, contractors, Wakefield.

Houses (101), Albany estate; L. Brown & Son, builders, Boathouse Lane, Stockton.

Torquay.—Four-storey block of flats, St. Luke's Road North; Florsams Property Co., Ltd., 12, Sackville Street, London, W.1.

Tynemouth.—Six-bay extension to Dukes & Markus's factory, North Shields; William Stockdale, architect, 73, Howard Street, North Shields.

West Hartlepool.—Proposed bus station; J. S. Miles, borough engineer.

Wigton.—Works extensions for British Rayophane, Ltd., Wigton.

Windermere.—Church, Queen's Drive; Gordon Stables, architect, Institute Buildings, Crescent Road.

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* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).